PATENT ABSTRACTS OF JAPAN

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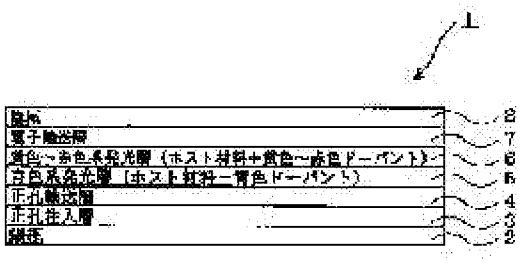
(54) WHITE COLOR GROUP ORGANIC ELECTROLUMINESCENT ELEMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a white color group organic EL element with few color change.

SOLUTION: The white color group electroluminescent element 1 of which, a light emitting layer is composed of a blue color group light emitting layer 5 and a yellow - red color group light emitting layer 6, is formed by laminating a positive electrode 2, the blue color group light emitting layer 5 containing host material and blue color group dopant, the yellow - red color group light emitting layer 6 containing host material same with that of the blue color light emitting layer and yellow - red color group dopant, and a negative electrode 8 in this sequence. For such an EL element of which, the light emitting layer is split into two, the tendency of emitted color, leaning toward red color side, is cancelled by forming the positive electrode 2 side light emitting layer of which, light emitting area tends to lean toward one side, by the blue color group light emitting layer 5. Accordingly, the thickness of the yellow - red color group light emitting layer 6 can be made thicker, and the color change becomes few.



* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]The anode, a host material and a blue system luminous layer containing a blue system dopant, and yellow - a red system luminous layer containing yellow - a red system dopant, [the same host material as said blue system luminous layer, and] A white system organic electroluminescence element which laminates and contains the negative pole in this order and by which a luminous layer is constituted from said blue system luminous layer, and said yellow - a red system luminous layer.
[Claim 2]The white system organic electroluminescence element according to claim 1 in which said blue system luminous layer contains an oxidizer.
[Claim 3]The white system organic electroluminescence element according to claim 1 in which the 1st organic layer is included and said 1st organic layer contains an oxidizer between said anode and said blue system luminous layer.
[Claim 4]The white system organic electroluminescence element according to any one of claims 1 to 3 in which said yellow - a red system luminous layer contain a reducing agent.
[Claim 5]The white system organic electroluminescence element according to any one of claims 1 to 3 in which the 2nd organic layer is included and said 2nd organic layer contains a reducing agent between said negative pole, and said yellow - a red system luminous layer.
[Claim 6]The white system organic electroluminescence element according to any one of claims 1 to 5 which contains an inorganic compound layer in contact with said anode and/or said negative pole.
[Claim 7]The white system organic electroluminescence element according to any one of claims 1 to 6 in which said host material is a styryl derivative, an anthracene derivative, or aromatic amine.
[Claim 8]The white system organic electroluminescence element according to claim 7 in which said styryl derivative is a JISUCHIRIRU derivative, a tris styryl derivative, a tetra styryl derivative, or a styryl amine derivative.
[Claim 9]The white system organic electroluminescence element according to claim 7 which is a compound in which said anthracene derivative contains a phenylanthracene skeleton.
[Claim 10]The white system organic electroluminescence element according to claim 7 in which said aromatic amine is 2, 3, or a compound contained four about a nitrogen atom replaced by aromatic series.
[Claim 11]The white system organic electroluminescence element according to claim 10 which is a compound in which said aromatic amine contains at least one alkenyl group further.
[Claim 12]The white system organic electroluminescence element according to any one of claims 1 to 11 in

which said blue system dopant is at least one kind of compound chosen from styryl amine, an amine substitution styryl compound, or a fused aromatic ring content compound.

[Claim 13]The white system organic electroluminescence element according to any one of claims 1 to 12 which is a compound in which said yellow - a red system dopant carry out two or more owners of the fluoranthene skeleton.

[Claim 14]The white system organic electroluminescence element according to any one of claims 1 to 13 which is a compound in which said yellow - a red system dopant contain an electron releasing group and a fluoranthene skeleton.

[Claim 15]The white system organic electroluminescence element according to any one of claims 1 to 14 said yellow - whose fluorescence peak wavelength of a red system dopant are 540 nm - 700 nm.

[Claim 16]The white system organic electroluminescence element according to any one of claims 1 to 15 whose thickness of said blue system luminous layer and said yellow - a red system luminous layer is not less than 5 nm.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to a white system organic electroluminescence element (it is hereafter written as an "organic EL device").
[0002]
[Description of the Prior Art]In recent years, since it can be used for the full color display etc. which use a lighting use and light filters, such as a use as a mono color display, and a back light, development of a white system organic EL device is performed positively. Since the chromaticity variation of a white system organic EL device not only spoils the grace as a product, but becomes a cause which causes the fall of color reproduction nature on the full color display display combined with the light filter, for example, a white system organic EL device with few chromaticity variations is required.
[0003]Many methods of obtaining white light by organic electroluminescence are indicated. That from which these methods obtain white only with one kind of luminescent material is little, and is making two kinds or three kinds of luminescent materials usually emit light simultaneously in one organic electroluminescence. When three kinds of luminescent materials were used, it was made white in the red corresponding to the three primary colors of light, and the combination of blue and green luminescence, but there was a problem that chromaticity control was difficult and repeated reproducibility was bad. When using two kinds of luminescent materials, the luminescent material of the yellow - the red system used as a blue system and its complementary color is chosen, but luminescence of yellow - a red system becomes strong in many cases, and tends to cause a chromaticity variation. For example, blue falls easily and the conventional white organic electroluminescence has a problem of a chromaticity variation as shown in the reference examples 1 and 2 of JP,2001-52870,A. A blue system dopant, and yellow - a red system dopant are doped simultaneously, and although white light is obtained, since it is easy to carry out energy transfer also of also adjusting a dope ratio to red from blue in addition to red becoming strong easily, it tends to become reddish white. Therefore, in order to have obtained white, yellow - a red system dopant needed to be doped very thin, and there was a problem that reproducibility was difficult too.
[0004]The electron hole transporting bed which adjoins a luminous layer has the method of doping yellow - red system material. In this method, since it is hard to pour an electron into an electron hole transporting bed, even if it dopes the yellow - the red system toward which luminescence tends to incline, red does not shine strongly. Therefore, it is easy to balance blue system luminescence for obtaining white light, and

yellow - red system luminescence, and it excels also in luminous efficiency and there is the strong point in which it is long-life. However, there was a serious problem that the chromaticity variation at the time of a continuation drive and high temperature preservation was large, from the problem of the distance dependence of energy transfer. Since the molecule of the excited red light is concentrated on the electron hole transporting bed side interface in this invention persons' knowledge, A chromaticity variation is carried out, because red light will change a lot although blue light is not changing so much if it changes even when the balance of an electron and a hole collapses by degradation, the concentration degree to an interface compares and it is small.

[0005]In the type which divides a luminous layer into two, there is a lamination type which made the anode side luminous layer yellow - a red system luminous layer, and used the negative pole side as the blue light layer. In this case, although excelled in the field of efficiency, in order to obtain white and to press down yellow - red system luminescence, compared with the blue system luminous layer, thickness needed to be made thin for yellow - a red system luminous layer, or dope concentration needed to be made thin, and element production was difficult. If thickness of yellow - a red system luminous layer was not about 1-2 nm, specifically, it did not become white light in many cases. It can be said that control is very difficult for it since this thickness is the molecular size of the usual low molecule system organic electroluminescence, and the thinness of an equivalent level.

[0006]

[Problem(s) to be Solved by the Invention]This invention aims to let a color change provide few white system organic EL devices in view of an aforementioned problem.

[0007]

[Means for Solving the Problem]In order to solve this technical problem, in a type which divides a luminous layer into two, it is making into a blue system luminous layer a luminous layer by the side of the anode toward which a luminous region of a luminous layer inclines easily, the luminescent color found out that a tendency that it tends to incline toward red could be negated, and this invention persons completed this invention.

[0008]A blue system luminous layer which contains the anode, and a host material and a blue system dopant according to the first mode of this invention, a blue system -- the same host material as a luminous layer, yellow - a red system luminous layer containing yellow - a red system dopant, and the negative pole are laminated and included in this order -- a blue system -- a white system by which a luminous layer is constituted from a luminous layer, and yellow - a red system luminous layer -- an organic electroluminescence element is provided.

[0009]Preferably, a blue system luminous layer contains an oxidizer. Preferably, the 1st organic layer is included between the anode and a blue system luminous layer, and the 1st organic layer contains an oxidizer. Preferably, yellow - a red system luminous layer contain a reducing agent. Preferably, the 2nd organic layer is included between the negative pole, and yellow - a red system luminous layer, and the 2nd organic layer contains a reducing agent. Preferably, an inorganic compound layer is included in contact with the anode and/or the negative pole.

[0010]Preferably, a host material is a styryl derivative, an anthracene derivative, or aromatic amine. Preferably, a styryl derivative is a JISUCHIRIRU derivative, a tris styryl derivative, a tetra styryl derivative, or a styryl amine derivative. Preferably, an anthracene derivative is a compound containing a

phenylanthracene skeleton. Preferably, aromatic amine is 2, 3, or a compound contained four about a nitrogen atom replaced by aromatic series, and is a compound containing at least one alkenyl group still more preferably.

[0011]Preferably, a blue system dopant is at least one kind of compound chosen from styryl amine, an amine substitution styryl compound, or a fused aromatic ring content compound. Preferably, yellow - a red system dopant are compounds which carry out two or more owners of the fluoranthene skeleton. Preferably, yellow - a red system dopant are the compounds containing an electron releasing group and a fluoranthene skeleton. Preferably, yellow - fluorescence peak wavelength of a red system dopant are 540 nm - 700 nm. Preferably, thickness of a blue system luminous layer and yellow - a red system luminous layer is not less than 5 nm.

[0012]

[A mode of implementation of an invention] By this invention, the anode, a blue system luminous layer, yellow - a red system luminous layer, and the negative pole have laminated in this order, and a luminous layer comprises two-layer [of a blue system luminous layer and yellow - a red system luminous layer]. A blue system luminous layer is in the anode side, yellow - a red system luminous layer are in the negative pole side, and a host material of a blue system luminous layer, and yellow - a red system luminous layer is the same substance further. Other layers can be made to intervene between a blue system luminous layer, and yellow - a red system luminous layer. Other organic layers or inorganic layers can be made to intervene between the anode and a blue system luminous layer or between yellow - a red system luminous layer, and the negative pole. The intervening layer can convey an electron and an electron hole, and if transparent, it will not be restricted. As a desirable example, the oxidation In, oxidation Sn, oxidation Zn, sulfuration Zn, the sulfuration Cd, and the nitriding Ga are mentioned. As composition of a white system organic EL device of this invention, For example, anode / blue system luminous layer / yellow - red system luminous layer / negative pole anode / electron hole transporting bed / blue system luminous layer / yellow - red system luminous layer / negative pole anode / blue system luminous layer / yellow - red system luminous layer / electron transport layer / negative pole anode / electron hole transporting bed / blue system luminous layer / yellow - red system luminous layer / electron transport layer / negative pole anode / hole injection layer/. Although there are an electron hole transporting bed / blue system luminous layer / yellow - a red system luminous layer / electron transport layer / negative pole anode / hole injection layer / electron hole transporting bed / blue system luminous layer / yellow - a red system luminous layer / electron transport layer / electronic injection layer / negative pole, etc., It will not be limited especially if a blue system luminous layer has laminated from yellow - a red system luminous layer to the anode side.

[0013]Drawing 1 is a mimetic diagram of one embodiment of a white system organic EL device of this invention. The white system organic EL device 1 has the structure which laminated the anode 2, the hole injection layer (the first organic layer) 3, the electron hole transporting bed 4, the blue system luminous layer 5, yellow - the red system luminous layer 6, the electron transport layer (the second organic layer) 7, and the negative pole 8. As for this white system organic EL device 1, a luminous layer consists only of bilayer lamination of the blue system luminous layer 5, and yellow - the red system luminous layer 6.

[0014]In a white system organic EL device of this invention, since the anode side is a blue system luminous layer, a tendency for the luminescent color to incline toward red can be negated. Therefore, in order to obtain white, it is not necessary to press down yellow - red system luminescence, and it is not necessary to

make thickness thin for yellow - a red system luminous layer compared with a blue system luminous layer, or to make dope concentration thin. As a result, since thickness of yellow - a red system luminous layer can be made thicker than before, there are few chromaticity variations. Since a host material of a blue system luminous layer, and yellow - a red system luminous layer is the same substance, it is hard to concentrate luminescence on an interface, and a blue light layer cannot receive influence by change of an interface easily. Since thickness of yellow - a red system luminous layer is large enough, it is hard to receive influence by change of an interface. Therefore, a white system organic EL device of this invention has few color changes, and it is at the bottom of hot environments, and continuation drive time, and especially, since it is hard to produce a color change, it can be used conveniently for information display equipment, mounted display equipment, a light, etc.

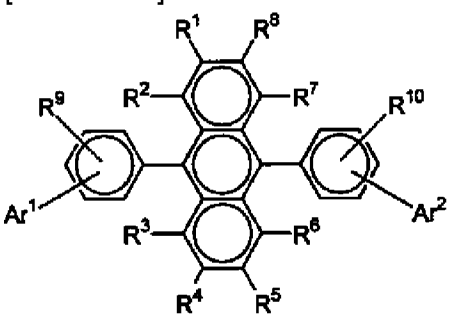
[0015]Hereafter, a blue system luminous layer and yellow - a red system luminous layer which are the characteristic portions of this invention are explained to a center. Therefore, since general composition can be taken, composition and a process of other organic layers, an inorganic compound layer, the anode, the negative pole, etc. are explained briefly.

[0016]1. A luminous layer (1) blue system luminous layer blue system luminous layer consists of a host material and a blue system dopant. As for a host material, it is preferred that they are a styryl derivative, an anthracene derivative, or aromatic amine. As for a styryl derivative, it is preferred that it is especially at least one kind chosen from a JISUCHIRIRU derivative, a tris CHIRIRU derivative, a tetra styryl derivative, and a styryl amine derivative. As for an anthracene derivative, it is preferred that it is especially a compound which has a phenylanthracene skeleton. As for aromatic amine, it is preferred that it is a compound which has 2-4 nitrogen atoms by which aromatic substitution was carried out, and especially its compound that has 2-4 nitrogen atoms by which aromatic substitution was carried out, and has at least one alkenyl group is preferred.

[0017]As the above-mentioned styryl derivative and an anthracene derivative, it is a following general formula, for example. [1]-A compound shown by [5] is a following general formula as the above-mentioned aromatic amine, for example. [6]-A compound shown by [7] is mentioned.

[0018]

[Formula 1]



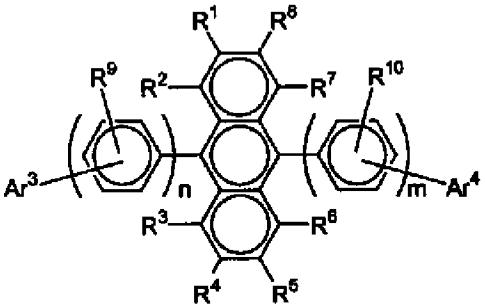
[1]

[0019][Independently R^1 - R^{10} among a formula, respectively A hydrogen atom, An alkyl group with 1-20 carbon atoms which are not replaced [a halogen atom, a cyano group, a nitro group, substitution, or], An aryloxy group with 6-30 carbon atoms which are not replaced [an alkoxy group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An arylthio group with 6-30 carbon atoms which are not replaced [an alkylthio group with 1-20 carbon atoms which are not replaced / substitution or /,

substitution or], It is a heterocycle group with 5-30 carbon atoms which are not replaced [a condensed multi-ring group with 10-30 carbon atoms which are not replaced / an arylated alkyl group with 7-30 carbon atoms which are not replaced / substitution or /, a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or]. Independently, Ar^1 and Ar^2 are alkenyl groups which are not replaced [an aryl group with 6-30 carbon atoms which are not replaced / substitution or /, substitution, or], and, respectively as a substituent, An alkoxy group with 1-20 carbon atoms which are not replaced [an alkyl group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An alkylthio group with 1-20 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], An arylated alkyl group with 6-30 carbon atoms which are not replaced [an arylthio group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is a heterocycle group with 5-30 carbon atoms which are not replaced [a condensed multi-ring group with 10-30 carbon atoms which are not replaced / a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or].]

[0020]

[Formula 2]



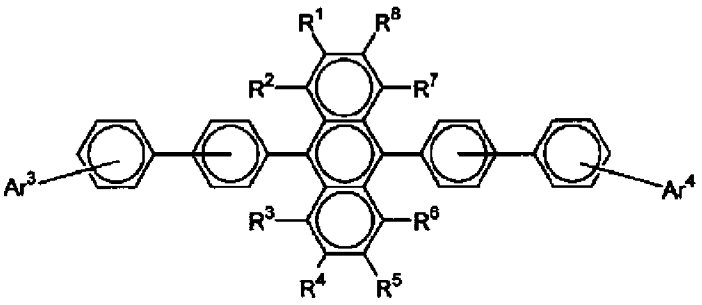
[2]

[0021][Independently R^1 - R^{10} among a formula, respectively A hydrogen atom, An alkyl group with 1-20 carbon atoms which are not replaced [a halogen atom, a cyano group, a nitro group, substitution, or], An aryloxy group with 6-30 carbon atoms which are not replaced [an alkoxy group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An arylthio group with 6-30 carbon atoms which are not replaced [an alkylthio group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], It is a heterocycle group with 5-30 carbon atoms which are not replaced [a condensed multi-ring group with 10-30 carbon atoms which are not replaced / an arylated alkyl group with 7-30 carbon atoms which are not replaced / substitution or /, a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or]. Independently, Ar^3 and Ar^4 are alkenyl groups which are not replaced [an aryl group with 6-30 carbon atoms which are not replaced / substitution or /, substitution, or], and, respectively as a substituent, An alkoxy group with 1-20 carbon atoms which are not replaced [an alkyl group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An alkylthio group with 1-20 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], An arylated alkyl group with 6-30 carbon atoms which are not replaced [an arylthio group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is an alkenyl group with 4-40 carbon atoms which are not replaced [a heterocycle group with 5-30 carbon atoms which are not replaced / a condensed multi-ring group with 10-30 carbon atoms which are not replaced / a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or /,

substitution, or]. 1-3m of n are 1-3, and n+m>=2.]

[0022]

[Formula 3]

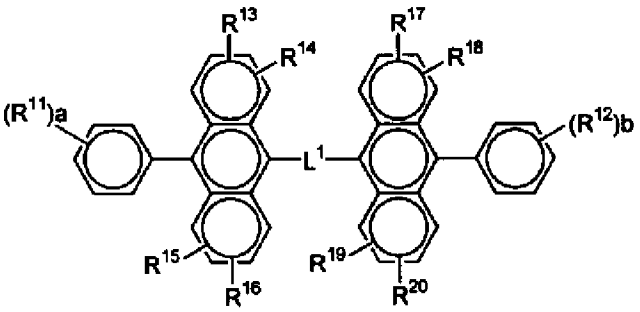


[3]

[0023][Independently R^1 - R^8 among a formula, respectively A hydrogen atom, An alkyl group with 1-20 carbon atoms which are not replaced [a halogen atom, a cyano group, a nitro group, substitution, or], An aryloxy group with 6-30 carbon atoms which are not replaced [an alkoxy group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An arylthio group with 6-30 carbon atoms which are not replaced [an alkylthio group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], It is a heterocycle group with 5-30 carbon atoms which are not replaced [a condensed multi-ring group with 10-30 carbon atoms which are not replaced / an arylated alkyl group with 7-30 carbon atoms which are not replaced / substitution or /, a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or]. Independently, Ar^3 and Ar^4 are alkenyl groups which are not replaced [an aryl group with 6-30 carbon atoms which are not replaced / substitution or /, substitution, or], and, respectively as a substituent, An alkoxy group with 1-20 carbon atoms which are not replaced [an alkyl group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An alkylthio group with 1-20 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], An arylated alkyl group with 6-30 carbon atoms which are not replaced [an arylthio group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is an alkenyl group with 4-40 carbon atoms which are not replaced [a heterocycle group with 5-30 carbon atoms which are not replaced / a condensed multi-ring group with 10-30 carbon atoms which are not replaced / a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or /, substitution, or].]

[0024]

[Formula 4]



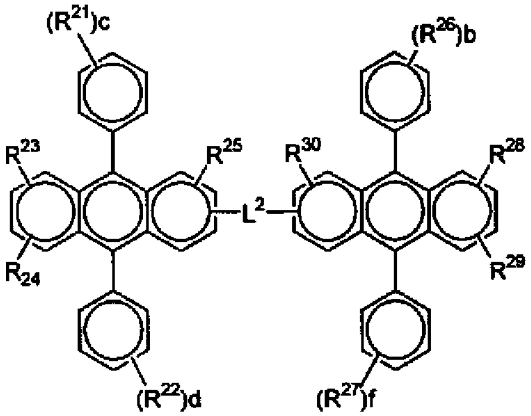
[4]

[0025][R^{11} - R^{20} among a formula, Independently, respectively A hydrogen atom, an alkenyl group, an alkyl group, a cycloalkyl group, An aryl group, an alkoxyl group, an aryloxy group, an alkylamino group, an

arylamino group, or the heterocyclic group that may be replaced is shown, and a and b, The integer of 1-5 is shown, respectively, and when they are two or more, R^{11} or R^{12}. In each, it may be the same or may differ, and R^{11} or R^{12} may join together, may form the ring, and, R^{13}, R^{14} and R^{15}, R^{16} and R^{17}, R^{18} and R^{19}, and R^{20} may combine with it being, and may form the ring. L^1 shows a single bond or -O-, -S-, -N(R)- (R is an alkyl group or an aryl group which may be replaced), or an allylene group.]

[0026]

[Formula 5]

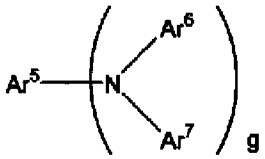


[5]

[0027][R^{21} - R^{30} among a formula, Independently, respectively A hydrogen atom, an alkenyl group, an alkyl group, a cycloalkyl group, An aryl group, an alkoxyl group, an aryloxy group, an alkylamino group, an arylamino group, or two or more cyclic group that may be replaced is shown, and c, d, e, and f, The integer of 1-5 is shown, respectively, and when they are two or more, R^{21}, R^{22}, R^{26}, or R^{27}. In each, it may be the same, or may differ and R^{21}.R^{22}, R^{26}, or R^{27} may join together, the ring may be formed, and R^{23}, R^{24} and R^{28}, and R^{29} may combine with it being, and may form the ring. L^2 shows a single bond or -O-, -S-, -N(R)- (R is an alkyl group or an aryl group which may be replaced), or an allylene group.]

[0028]

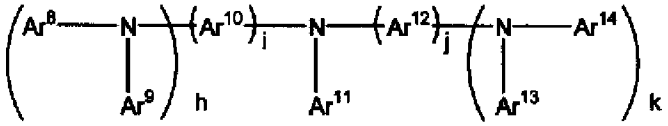
[Formula 6]



[6]

[0029][Among a formula, Ar^5, Ar^6, and Ar^7 show independently the aromatic group of the monovalence which is not replaced [substitution with 6-40 carbon atoms, or], respectively, at least one in them may contain the styryl group, and g shows the integer of 1-4.]

[Formula 7]



[7]

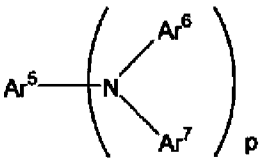
[0030][Ar^8, Ar^9, Ar^{11}, Ar^{13}, and Ar^{14} among a formula, The aromatic group of the monovalence which is not replaced [substitution with 6-40 carbon atoms or] is shown independently, respectively, and Ar^{10} and Ar^{12},

The aromatic group of the bivalence which is not replaced [substitution with 6-40 carbon atoms or] is shown independently, respectively, at least one of Ar^8 - the Ar^{14} may contain the styryl group or the Styr Wren group, and the integer of 0-2, and i and j of h and k are the integers of 0-3, respectively.]

[0031]As for a blue system dopant, it is preferred that it is at least one kind chosen from styryl amine, an amine substitution styryl compound, and a fused aromatic ring content compound. Then, a blue system dopant comprises several different compounds, and its potato is good. As the above-mentioned styryl amine and an amine substitution styryl compound, it is a following general formula, for example. [8]-A compound shown by [9] is a following general formula as the above-mentioned fused aromatic ring content compound, for example. A compound shown by [10] is mentioned.

[0032]

[Formula 8]

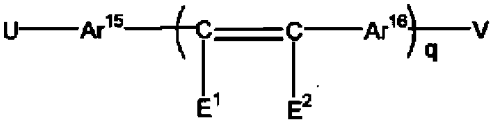


[8]

[0033][Ar^5, Ar^6, and Ar^7 show independently the aromatic group which is not replaced [substitution with 6-40 carbon atoms, or] among a formula, respectively, and, as for p, at least one in them shows the integer of 1-3 including a styryl group.]

[0034]

[Formula 9]

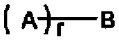


[9]

[0035][Among a formula, independently, the allylene group, E^1, and E^2 with 6-30 carbon atoms show an aryl group or an alkyl group, a hydrogen atom, or a cyano group with 6-30 carbon atoms independently, respectively, and, as for Ar^{15} and Ar^{16}, q shows the integer of 1-3, respectively. U and/or V are the substituents containing an amino group, and are preferred in this amino group being an arylamino group.]

[0036]

[Formula 10]



[10]

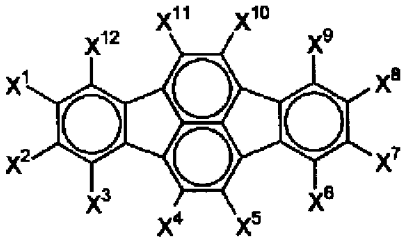
[0037][A among a formula An alkyl group or an alkoxy group with 1-16 carbon atoms, The arylamino group which is not replaced [substitution with the alkylamino group which is not replaced / substitution with the aryl group which is not replaced / substitution with 6-30 carbon atoms or / and 6-30 carbon atoms or / or 6-30 carbon atoms or] and B show a fused aromatic ring group with 10-40 carbon atoms, and r shows the integer of 1-4.]

[0038](2) Yellow - red system luminous layer yellow - a red system luminous layer consist of a host material, and yellow - a red system dopant. A host material uses the same thing as a host material used by a blue system luminous layer. When different host materials are used, since a color change becomes large, it is not desirable. A fluorescent compound which has at least one fluoranthene skeleton or a perylene skeleton can

be used for yellow - a red system dopant, for example, they are a following general formula. [11]-A compound shown by [27] is mentioned.

[0039]

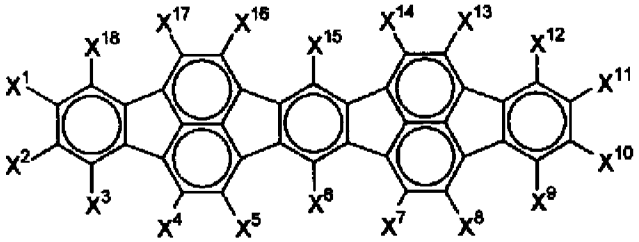
[Formula 11]



[11]

[0040]

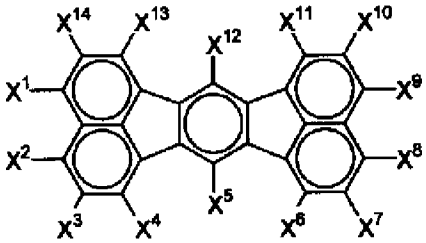
[Formula 12]



[12]

[0041]

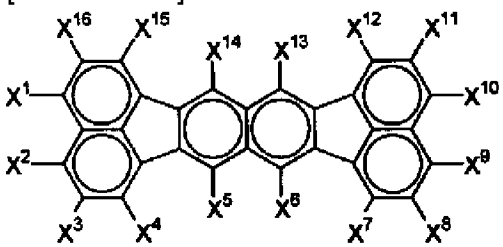
[Formula 13]



[13]

[0042]

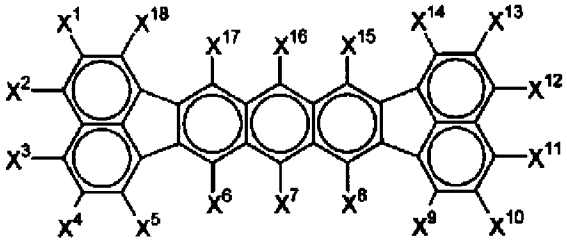
[Formula 14]



[14]

[0043]

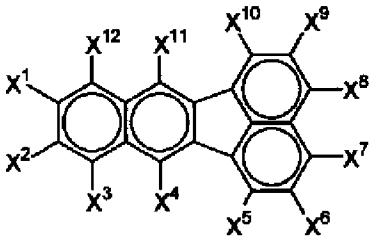
[Formula 15]



[15]

[0044]

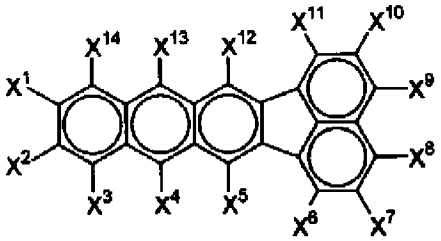
[Formula 16]



[16]

[0045]

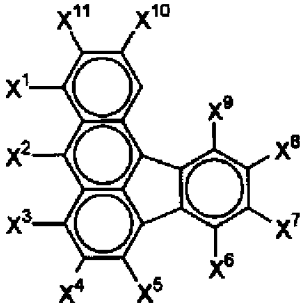
[Formula 17]



[17]

[0046]

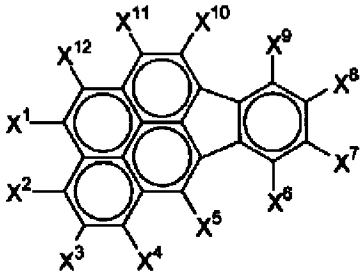
[Formula 18]



[18]

[0047]

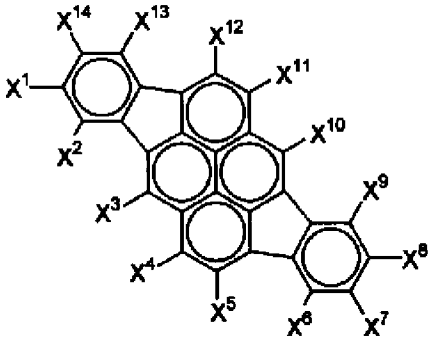
[Formula 19]



[19]

[0048]

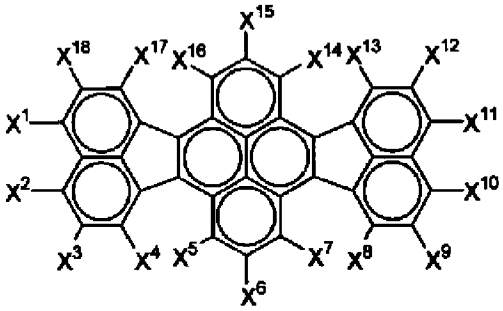
[Formula 20]



[20]

[0049]

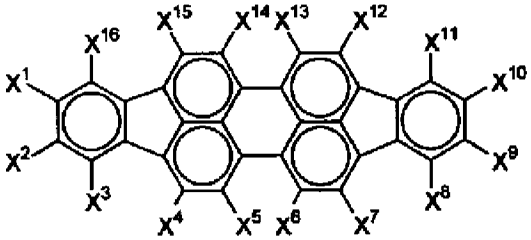
[Formula 21]



[21]

[0050]

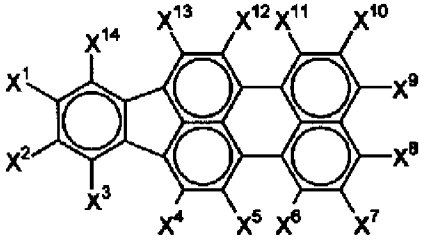
[Formula 22]



[22]

[0051]

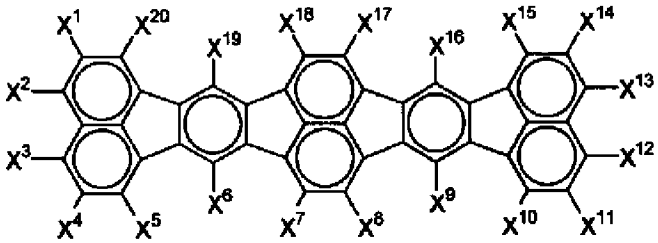
[Formula 23]



[23]

[0052]

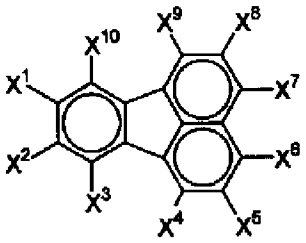
[Formula 24]



[24]

[0053]

[Formula 25]

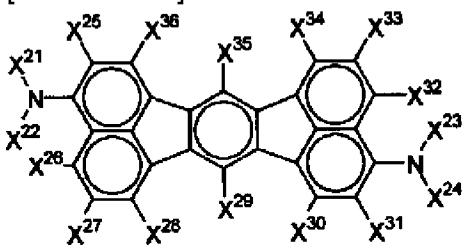


[25]

[0054][General formula [11]-[25]Independently X^1 - X^{20} among a formula, respectively A hydrogen atom, An alkyl group with a straight chain, branching, or 1-20 annular carbon atoms, a straight chain, An aryl group with 6-30 carbon atoms which are not replaced [an alkoxy group with branching or 1-20 annular carbon atoms, substitution or], An arylamino group with 6-30 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is an alkenyl group with an aryl alkylamino group with 7-30 carbon atoms which are not replaced [an alkylamino group with 1-30 carbon atoms which are not replaced / substitution or /, substitution, or], substitution, or 8-30 unreplaced carbon atoms, An adjoining substituent and X^1 - X^{20} may form cyclic structure unitedly. A substituent may be the same when the adjoining substituent is an aryl group.]General formula[11]-[25]When the compound of a formula contains an amino group or an alkenyl group, it is preferred.

[0055]

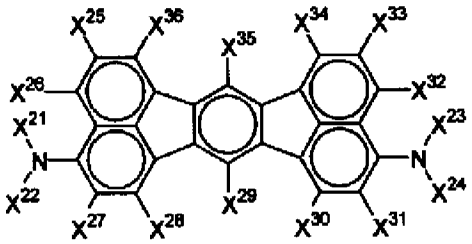
[Formula 26]



[26]

[0056]

[Formula 27]



[27]

[0057][General formula [26]-[27]Independently X^{21} - X^{24} among a formula, respectively An alkyl group with 1-20 carbon atoms, It is an aryl group with 6-30 carbon atoms which are not replaced [substitution or], and X^{21}, X^{22} and/or X^{23}, and X^{24} may be combined via carbon-carbon bonding or -O-, and -S-. X^{25} - X^{36} A hydrogen atom, a straight chain, branching, or an alkyl group with 1-20 annular carbon atoms, An aryl group with 6-30 carbon atoms which are not replaced [an alkoxy group with a straight chain, branching, or 1-20 annular carbon atoms, substitution, or], An arylamino group with 6-30 carbon atoms which are not replaced

[an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is an alkenyl group with an aryl alkylamino group with 7-30 carbon atoms which are not replaced [an alkylamino group with 1-30 carbon atoms which are not replaced / substitution or /, substitution, or], substitution, or 8-30 unreplaced carbon atoms, An adjoining substituent and X^{25} - X^{36} may form cyclic structure unitedly. It is desirable when at least one of substituent X^{25} in each formula - the X^{36} contains amine or an alkenyl group.]

[0058]As for a fluorescent compound which has a fluoranthene skeleton, in order efficient and to acquire a long life, it is preferred to contain an electron releasing group, and a desirable electron releasing group is an arylamino group which is not replaced [substitution or]. As for a fluorescent compound which has a fluoranthene skeleton, five or more are preferred in the number of condensed rings, and six especially or more are preferred. This is because a fluorescent compound shows fluorescence peak wavelength of 540-700 nm, luminescence from a fluorescent compound laps with a blue system luminescent material and it assumes white. When the above-mentioned fluorescent compound carries out two or more owners of the fluoranthene skeleton, since the luminescent color serves as a red spectrum region from yellow, it is preferred. Especially a desirable fluorescent compound has an electron releasing group, a fluoranthene skeleton, or a perylene skeleton, and shows fluorescence peak wavelength of 540-700 nm.

[0059]5-30 nm of thickness [7-30 nm of] of a blue system luminous layer is 10-30 nm preferably. In less than 5 nm, when there is a possibility that luminous layer formation may become difficult and adjustment of a chromaticity may become difficult and it exceeds 30 nm, there is a possibility that driver voltage may go up. 10-50 nm of thickness [20-50 nm of] of yellow - a red system luminous layer is 30-50 nm preferably. In less than 10 nm, when there is a possibility that luminous efficiency may fall and it exceeds 50 nm, there is a possibility that driver voltage may go up.

[0060]2. Organic layer (1) which is others Between the first organic layer anode and a blue system luminous layer, a hole injection layer, an electron hole transporting bed, or an organic semiconductor layer can be provided as the first organic layer. It is a layer which helps a hole injection to a luminous layer and is conveyed to a luminous region, a hole injection layer or an electron hole transporting bed has large hole mobility, and its ionization energy is usually as small as 5.5 eV or less. A hole injection layer provides easing a sudden change of energy level etc. in order to adjust energy level. Material which conveys an electron hole to a luminous layer with lower field intensity as such a hole injection layer or an electron hole transporting bed is preferred, That whose mobility of an electron hole is $10^{-6}cm^2/V$ and a second at least, for example at the time of an applied electric field of 10^4 - 10^6V/cm is still more preferred. As a material which forms a hole injection layer or an electron hole transporting bed, If it has the aforementioned desirable character, there will be no restriction in particular, and arbitrary things can be conventionally chosen and used out of what is commonly used as a charge transporting material of an electron hole in photoconductive material, and a publicly known thing currently used for a hole injection layer of an organic EL device.

[0061]As a formation material of such a hole injection layer or an electron hole transporting bed, Specifically, for example A triazole derivative (references, such as a U.S. Pat. No. 3,112,197 item specification), An oxadiazole derivative (references, such as a U.S. Pat. No. 3,189,447 item specification), an imidazole derivative (references, such as JP,37-16096,B) and a poly aryl alkane derivative (a U.S. Pat. No. 3,615,402 item specification.) A 3,820,989 specification, a 3,542,544 specification, JP,45-555,B, a 51-10983 gazette,

JP,51-93224,A, A 55-17105 gazette, a 56-4148 gazette, a 55-108667 gazette, References, such as a 55-156953 gazette and a 56-36656 gazette, a pyrazoline derivative and a pyrazolone derivative (a U.S. Pat. No. 3,180,729 specification.) A 4,278,746 specification, JP,55-88064,A, References, such as a 55-88065 gazette, a 49-105537 gazette, a 55-51086 gazette, a 56-80051 gazette, a 56-88141 gazette, a 57-45545 gazette, a 54-112637 gazette, and a 55-74546 gazette, a phenylenediamine derivative (a U.S. Pat. No. 3,615,404 specification.) JP,51-10105,B, a 46-3712 gazette, a 47-25336 gazette, References, such as JP,54-53435,A, a 54-110536 gazette, and a 54-119925 gazette, an arylamine derivative (a U.S. Pat. No. 3,567,450 specification and a 3,180,703 specification.) A 3,240,597 specification, a 3,658,520 specification, A 4,232,103 specification, a 4,175,961 specification, A 4,012,376 specification, JP,49-35702,B, A 39-27577 gazette, JP,55-144250,A, a 56-119132 gazette, References, such as a 56-22437 gazette and the West German patent No. 1,110,518 specification, An amino substitution chalcone derivative (references, such as a U.S. Pat. No. 3,526,501 specification), An oxazole derivative (thing of an indication on U.S. Pat. No. 3,257,203 specifications etc.), a styryl anthracene derivative (references, such as JP,56-46234,A), a fluorenone derivative (references, such as JP,54-110837,A), a hydrazone derivative (a U.S. Pat. No. 3,717,462 specification and JP,54-59143,A.) A 55-52063 gazette, a 55-52064 gazette, a 55-46760 gazette, A 55-85495 gazette, a 57-11350 gazette, a 57-148749 gazette, references, such as JP,2-311591,A, and a stilbene derivative (JP,61-210363,A.) The No. 228451 [61 to] gazette, a 61-14642 gazette, a 61-72255 gazette, A 62-47646 gazette, a 62-36674 gazette, a 62-10652 gazette, A 62-30255 gazette, a 60-93455 gazette, a 60-94462 gazette, References, such as a 60-174749 gazette and a 60-175052 gazette, A silazane derivative (U.S. Pat. No. 4,950,950 specification), a polysilane system (JP,2-204996,A), Conductive polymer oligomer (especially thiophene oligomer) etc. which are indicated by an aniline system copolymer (JP,2-282263,A) and JP,1-211399,A can be mentioned.

[0062]As a material of a hole injection layer or an electron hole transporting bed, although the above-mentioned thing can be used, A porphyrin compound (thing of an indication to JP,63-2956965,A etc.), an aromatic tertiary-amine compound and a styryl amine compound (a U.S. Pat. No. 4,127,412 specification.) JP,53-27033,A, a 54-58445 gazette, a 54-149634 gazette, Reference and aromatic tertiary-amine compounds, such as a 54-64299 gazette, a 55-79450 gazette, a 55-144250 gazette, a 56-119132 gazette, a 61-295558 gazette, a 61-98353 gazette, and a 63-295695 gazette, can also be used. . Have in intramolecular two fused aromatic rings indicated to U.S. Pat. No. 5,061,569. For example, 4,4'-bis(N-(1-naphthyl)-N-phenylamino)biphenyl, A triphenylamine unit indicated to JP,4-308688,A can mention a 4,4',4"-tris(N-(3-methylphenyl)-N-phenylamino) triphenylamine etc. which were connected with 3 starburst type. Inorganic compounds, such as p type Si, p type SiC, etc. besides the above-mentioned aromatic JIMECHIRI DIN system compound shown as a material of a luminous layer, can also be used as a material of a hole injection layer or an electron hole transporting bed.

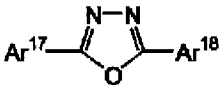
[0063]This hole injection layer or an electron hole transporting bed may laminate a hole injection layer or an electron hole transporting bed which may comprise one layer which consists of one sort of material mentioned above, or two sorts or more, and turns into a hole injection layer or an electron hole transporting bed from a compound of another kind. Although thickness in particular of a hole injection layer or an electron hole transporting bed is not limited, it is 20-200 nm preferably.

[0064]An organic semiconductor layer is a layer which helps a hole injection or electron injection to a luminous layer, and what has the conductivity more than 10^{-10}S/cm is preferred for it. As a material of such

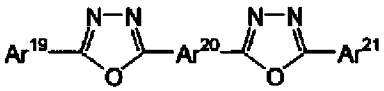
an organic semiconductor layer, conductive dendrimers, such as conductive oligomer, such as ** thiophene oligomer and ** arylamine oligomer given in JP,8-193191,A, and a ** arylamine dendrimer, etc. can be used. Although thickness in particular of an organic semiconductor layer is not limited, it is 10-1,000 nm preferably.

[0065](2) Between the second organic layer negative pole, and yellow - a red system luminous layer, an electronic injection layer or an electron transport layer can be provided as the second organic layer. An electronic injection layer or an electron transport layer is a layer which helps pouring of an electron to a luminous layer, and its electron mobility is large.An electronic injection layer provides easing a sudden change of energy level etc. in order to adjust energy level. As a material used for an electronic injection layer or an electron transport layer, a metal complex of 8-hydroxyquinoline or its derivative is preferred.As an example of a metal complex of the above-mentioned 8-hydroxyquinoline or its derivative, a metal chelate oxy NOIDO compound, for example, tris(eight quinolinol) aluminum, containing chelate of oxine (generally an eight quinolinol or 8-hydroxyquinoline) can be used. And as an oxadiazole derivative, it is following general formula [28] - [30]. [0066]

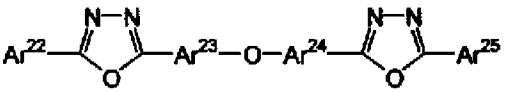
[Formula 28]



[28]



[29]

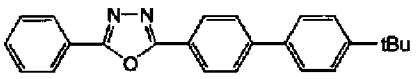


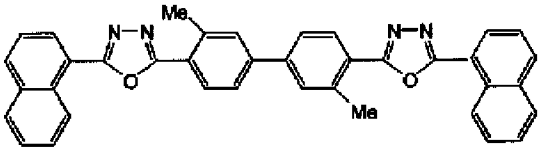
[30]

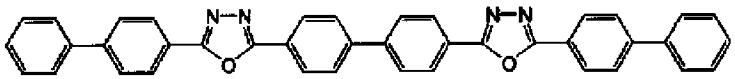
[0067](Ar^{17}, Ar^{18}, Ar^{19}, Ar^{21}, Ar^{22}, and Ar^{25} among a formula) The aryl group which it does not have or it has a substituent, respectively is shown, and Ar^{17}, Ar^{18} and Ar^{19}, Ar^{21} and Ar^{22}, and Ar^{25} may be mutually the same, or may differ from each other. Ar^{20}, Ar^{23}, and Ar^{24} show the allylene group which it does not have or it has a substituent, respectively, may be mutually the same, or may differ. The electron transport compound expressed is mentioned. [of Ar^{23} and Ar^{24}] These general formulas [28] As an aryl group in - [30], a phenyl group, a biphenyl group, an anthranil, a peri RENIRU group, a pyrenyl group, etc. are mentioned. As an allylene group, a phenylene group, a naphthylene group, a biphenylene group, the Ain Trani Wren group, the Pelli Reni Wren group, a pyrenylene group, etc. are mentioned. And as a substituent to these, the alkyl group of the carbon numbers 1-10, the alkoxy group of the carbon numbers 1-10, or a cyano group is mentioned. What has thin-film-forming nature good [this electron transport compound] is used preferably. And the following can be mentioned as an example of these electron transport nature compound.

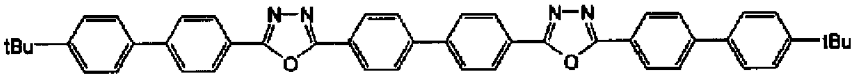
[0068]

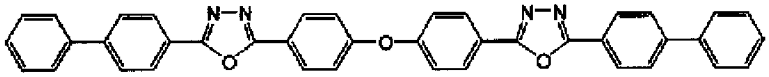
[Formula 29]











Although the thickness in particular of an electronic injection layer or an electron transport layer is not limited, it is 1-100 nm preferably.

[0069]It is preferred that the blue system luminous layer or the first organic layer nearest to the anode which is an organic layer contains the oxidizer. The desirable oxidizer contained in a luminous layer or the first organic layer is electronic suction nature or an electronic acceptor. They are the salts preferably formed with a Lewis acid, various quinone derivative, and dicyanoquinodimethane derivative, and aromatic amine and Lewis acid. Especially desirable Lewis acid is ferric chloride, an antimony chloride, an aluminium chloride, etc.

[0070]It is preferred that the yellow - the red system luminous layer, or the second organic layer which is an organic layer nearest to the negative pole contains the reducing agent. A desirable reducing agent is a complex formed with an alkaline metal, alkaline-earth metals, an alkali metal oxide, an alkaline earth oxide, a rare earth oxide, alkali metal halides, an alkaline earth halogenide, a rare earth halogenide, and an alkaline metal and aromatic compounds. Especially desirable alkaline metals are Cs, Li, Na, and K.

[0071]3. In contact with the inorganic compound layer anode and/or the negative pole, it may have an inorganic compound layer. An inorganic compound layer functions as an adhesion improvement layer. As a desirable inorganic compound used for an inorganic compound layer, An alkali metal oxide, an alkaline earth oxide, a rare earth oxide, alkali metal halides, An alkaline earth halogenide, a rare earth halogenide, SiO_X, They are various oxides, such as AlO_X, SiN_X, SiON, AlON, GeO_X, LiO_X, LiON, TiO_X, TiON, TaO_X, TaON, TaN_X, and C, a nitride, and an oxidation nitride. As an ingredient of a layer which touches especially the anode, SiO_X, AlO_X, SiN_X, SiON, AlON, GeO_X, and C form a stable pouring volume phase, and are preferred. As an ingredient of a layer which touches especially the negative pole, LiF, MgF_2, CaF_2, MgF_2, and NaF are preferred. Although thickness in particular of an inorganic compound layer is not limited, it is 0.1 nm - 100 nm preferably.

[0072]Although a method in particular of forming each organic layer and an inorganic compound layer containing a luminous layer is not limited, it can apply publicly known methods, such as vacuum deposition, a spin coat method, the cast method, and the LB method, for example. Since the characteristic of an organic

EL device obtained becomes uniform and production time can be shortened, forming by same method is preferred, for example, when producing an electronic injection layer with vacuum deposition, it is preferred [an electronic injection layer and a luminous layer] that a luminous layer also produces a film with vacuum deposition.

[0073]4. It is preferred to use large (for example, not less than 4.0 eV) metal, an alloy, electrical conductivity compounds, or these mixtures of a work function as the electrode anode. It is independent or, specifically, one sort, such as indium tin oxide (ITO), indium zinc oxide, tin, a zinc oxide, gold, platinum, and palladium, can be used combining two or more sorts.

[0074]Although thickness in particular of the anode is not restricted, either, it is preferred to consider it as a value within the limits of 10-1,000 nm, and it is more preferred to consider it as a value within limits which are 10-200 nm.

[0075]It is preferred to use small (for example, less than 4.0 eV) metal, an alloy, electric conductivity compounds, or these mixtures of a work function for the negative pole. It is independent or, specifically, one sort, such as magnesium, aluminum, indium, lithium, sodium, and silver, can be used combining two or more sorts. Although thickness in particular of the negative pole is not restricted, either, it is preferred to consider it as a value within the limits of 10-1000 nm, and it is more preferred to consider it as a value within limits which are 10-200 nm. As for either [at least] the anode or the negative pole it is substantially preferred transparence and that light transmittance is more specifically not less than 10% of value so that light emitted from a luminous layer can be taken out effective in the exterior. An electrode can be manufactured with a vacuum deposition method, sputtering process, the ion plating method, electron beam evaporation method, a CVD method, the MOCVD method, plasma CVD method, etc. [0076]Hereafter, this invention is not limited by these examples although an example of this invention is described. The evaluation of an organic EL device obtained in each example is as follows.

(1) Initial performance : CIE1931 chromaticity coordinate measured and estimated a chromaticity.

(2) Life : the constant current drive was carried out by initial luminance 1000 cd/m^2, and half-life of luminosity and change of a chromaticity estimated.

(3) Heat resistance : a retention test was carried out at 105 ** and a chromaticity variation 500 hours after estimated. L/J change is change when early L/J expressed with a ratio of the luminosity L to the current density J is set to one.

[0077]

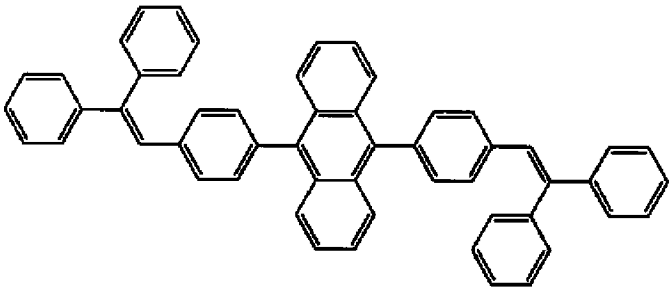
[Example]After cleaning ultrasonically the glass substrate with an ITO transparent electrode (anode) (made by a JIOMA tick company) of 75 mm x example 1(formation of organic EL device)25-mmx1.1-mm thickness for 5 minutes in isopropyl alcohol, UV ozone wash was performed for 30 minutes. The substrate holder of a vacuum evaporator is equipped with the glass substrate with a transparent electrode line after washing, So that said transparent electrode may be covered on the field of the side in which the transparent electrode line is formed first. It carried out and the N,N'-bis(N,N'-diphenyl-4-aminophenyl)-N,N-diphenyl-4,4'-diamino-1,1'-biphenyl film (it outlines the following "TPD232 film") of 60 nm of thickness was formed. This TPD232 film functions as a hole injection layer. The 4,4'-screw [N-(1-naphthyl)-N-phenylamino] biphenyl film (it outlines the following "NPD film") of 20 nm of thickness was formed on this TPD232 film after membrane formation of TPD232 film. This NPD film functions as an electron hole transporting bed.

[0078]It continues to membrane formation of a NPD film, and is a formula at 10 nm of thickness. The styryl

derivative DPVPDAN and formula which are shown by [31] B1 shown by [32] was vapor-deposited by the weight ratio of 40:1, membranes were formed, and it was considered as the blue system luminous layer. Subsequently, they are the styryl derivative DPVPDAN and a formula at 30 nm. R1 (fluorescence peak wavelength of 545 nm) shown by [33] was vapor-deposited by the weight ratio of 40:1, membranes were formed, and it was considered as yellow - a red system luminous layer. On this film, the tris (eight quinolinol) aluminum film (it outlines the following "Alq film".) of 10 nm of thickness was formed as an electron transport layer. then, Li (the source of Li: made by a SAESU getter company) and Alq -- duality -- it was made to vapor-deposit and 10 nm of Alq:Li films were formed as an electronic injection layer. On this Alq:Li film, 150 nm of metal aluminum was made to vapor-deposit, metal cathode was formed, and the organic electroluminescence light emitting device was formed.

[0079]

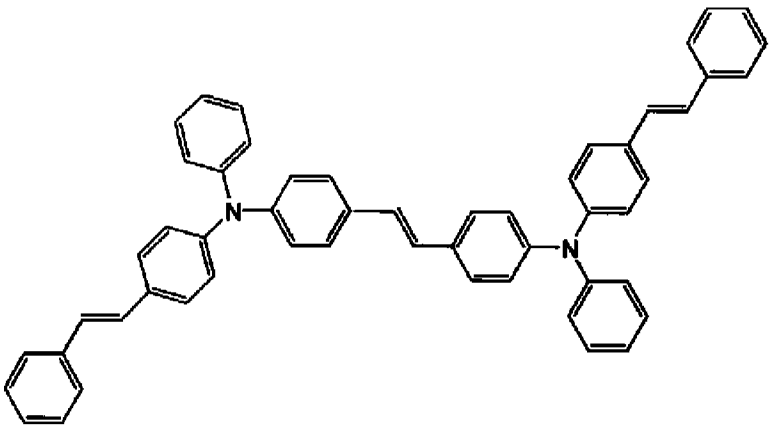
[Formula 30]



[31]

[0080]

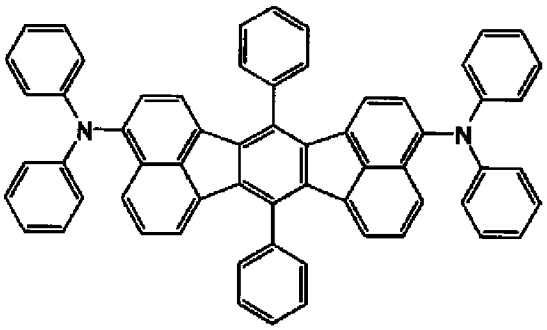
[Formula 31]



[32]

[0081]

[Formula 32]



[33]

[0082](Quality assessment of an organic EL device) As for this element, the white light of light-emitting-

luminance 100 cd/m^2 and efficiency 7 cd/A maximum light-emitting-luminance 110,000 cd/m^2 was obtained with the direct current voltage 5V. In CIE1931 chromaticity coordinate, the element produced with this material is = (x, y) (0.282-0.281), and was checked as it is white. When the constant current drive of this element was carried out by initial luminance 1000 cd/m^2, a life is 10,000 hours and was excellent. When the retention test was carried out at 105 **, the chromaticity after 500 hours is (0.278-0.271), and it has checked that the color differences in examination order were (-0.004, -0.010), and were excellent. The initial performance, the life, and the heat-resistant measurement result of the organic EL device obtained by Example 1 and the following comparative examples 1-3 are shown in Table 1. It is long-life, the organic EL device of this example had high heat resistance, and there were few color changes so that clearly from this table.

[0083]The element was produced like comparative example 1 Example 1. However, on a NPD film, vapor-deposit the styryl derivative DPVDPAN and a compound (R1) by the weight ratio of 100:1 at 10 nm, and it is considered as yellow - a red system luminous layer, Furthermore, the styryl derivative DPVDPAN and the compound (B1) were vapor-deposited by the weight ratio of 40:1, membranes were formed by 10 nm of thickness, and it was considered as the blue system luminous layer. However, it was set to (0.417-0.436), and a chromaticity became yellow light rather than was white. Although a 105 ** retention test was carried out, compared with Example 1, the chromaticity variation was very large.

[0084]The element was produced like comparative example 2 Example 1. However, on a NPD film, vapor-deposit the styryl derivative DPVDPAN and a compound (R1) by the weight ratio of 300:1 at 5 nm, and it is considered as yellow - a red system luminous layer, Furthermore, the styryl derivative DPVDPAN and the compound (B1) were vapor-deposited by the weight ratio of 40:1, membranes were formed by 38 nm of thickness, and it was considered as the blue system luminous layer. The chromaticity was set to (0.321-0.341) and good white was obtained. However, in a 105 ** retention test, the chromaticity variation became large compared with Example 1.

[0085]Element production was carried out like comparative example 3 Example 1. however, NPD, simultaneously (R1) were doped at a rate of 40:1 as an electron hole transporting bed. The luminous layer was made only into the blue system luminous layer, and the thickness of the blue system luminous layer was 40 nm.

[0086]

[Table 1]

	初期性能	室温連続駆動		耐熱性	
	色度	半減寿命 (h)	色度変化	L/J 変化	色度変化
実施例 1	(0.282, 0.281)	10000	(0.015, 0.015)	1.17	(-0.004, -0.010)
比較例 1	(0.417, 0.436)	7000	(0.015, 0.020)	1.44	(0.024, 0.034)
比較例 2	(0.321, 0.341)	10000	(0.015, 0.015)	1.20	(0.012, 0.019)
比較例 3	(0.330, 0.345)	8000	(0.018, 0.024)	1.20	(0.025, 0.036)

[0087]

[Effect of the Invention]A white system organic EL device with few this invention ****** and color changes can be provided.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention]This invention relates to a white system organic electroluminescence element (it is hereafter written as an "organic EL device").

[Translation done.]

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PRIOR ART

[Description of the Prior Art]In recent years, since it can be used for the full color display etc. which use a lighting use and light filters, such as a use as a mono color display, and a back light, development of a white system organic EL device is performed positively. Since the chromaticity variation of a white system organic EL device not only spoils the grace as a product, but becomes a cause which causes the fall of color reproduction nature on the full color display display combined with the light filter, for example, a white system organic EL device with few chromaticity variations is required.
[0003]Many methods of obtaining white light by organic electroluminescence are indicated. That from which these methods obtain white only with one kind of luminescent material is little, and is making two kinds or three kinds of luminescent materials usually emit light simultaneously in one organic electroluminescence. When three kinds of luminescent materials were used, it was made white in the red corresponding to the three primary colors of light, and the combination of blue and green luminescence, but there was a problem that chromaticity control was difficult and repeated reproducibility was bad. When using two kinds of luminescent materials, the luminescent material of the yellow - the red system used as a blue system and its complementary color is chosen, but luminescence of yellow - a red system becomes strong in many cases, and tends to cause a chromaticity variation. For example, blue falls easily and the conventional white organic electroluminescence has a problem of a chromaticity variation as shown in the reference examples 1 and 2 of JP,2001-52870,A. A blue system dopant, and yellow - a red system dopant are doped simultaneously, and although white light is obtained, since it is easy to carry out energy transfer also of also adjusting a dope ratio to red from blue in addition to red becoming strong easily, it tends to become reddish white. Therefore, in order to have obtained white, yellow - a red system dopant needed to be doped very thin, and there was a problem that reproducibility was difficult too.
[0004]The electron hole transporting bed which adjoins a luminous layer has the method of doping yellow - red system material. In this method, since it is hard to pour an electron into an electron hole transporting bed, even if it dopes the yellow - the red system toward which luminescence tends to incline, red does not shine strongly. Therefore, it is easy to balance blue system luminescence for obtaining white light, and yellow - red system luminescence, and it excels also in luminous efficiency and there is the strong point in which it is long-life. However, there was a serious problem that the chromaticity variation at the time of a continuation drive and high temperature preservation was large, from the problem of the distance dependence of energy transfer. Since the molecule of the excited red light is concentrated on the electron hole transporting bed side interface in this invention persons' knowledge, A chromaticity variation is carried

out, because red light will change a lot although blue light is not changing so much if it changes even when the balance of an electron and a hole collapses by degradation, the concentration degree to an interface compares and it is small.

[0005]In the type which divides a luminous layer into two, there is a lamination type which made the anode side luminous layer yellow - a red system luminous layer, and used the negative pole side as the blue light layer. In this case, although excelled in the field of efficiency, in order to obtain white and to press down yellow - red system luminescence, compared with the blue system luminous layer, thickness needed to be made thin for yellow - a red system luminous layer, or dope concentration needed to be made thin, and element production was difficult. If thickness of yellow - a red system luminous layer was not about 1-2 nm, specifically, it did not become white light in many cases. It can be said that control is very difficult for it since this thickness is the molecular size of the usual low molecule system organic electroluminescence, and the thinness of an equivalent level.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention]A white system organic EL device with few this invention ****** and color changes can be provided.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]This invention aims to let a color change provide few white system organic EL devices in view of an aforementioned problem.

[Translation done.]

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MEANS

[Means for Solving the Problem]In order to solve this technical problem, in a type which divides a luminous layer into two, it is making into a blue system luminous layer a luminous layer by the side of the anode toward which a luminous region of a luminous layer inclines easily, the luminescent color found out that a tendency that it tends to incline toward red could be negated, and this invention persons completed this invention.

[0008]A blue system luminous layer which contains the anode, and a host material and a blue system dopant according to the first mode of this invention, a blue system -- the same host material as a luminous layer, yellow - a red system luminous layer containing yellow - a red system dopant, and the negative pole are laminated and included in this order -- a blue system -- a white system by which a luminous layer is constituted from a luminous layer, and yellow - a red system luminous layer -- an organic electroluminescence element is provided.

[0009]Preferably, a blue system luminous layer contains an oxidizer. Preferably, the 1st organic layer is included between the anode and a blue system luminous layer, and the 1st organic layer contains an oxidizer. Preferably, yellow - a red system luminous layer contain a reducing agent. Preferably, the 2nd organic layer is included between the negative pole, and yellow - a red system luminous layer, and the 2nd organic layer contains a reducing agent. Preferably, an inorganic compound layer is included in contact with the anode and/or the negative pole.

[0010]Preferably, a host material is a styryl derivative, an anthracene derivative, or aromatic amine. Preferably, a styryl derivative is a JISUCHIRIRU derivative, a tris styryl derivative, a tetra styryl derivative, or a styryl amine derivative. Preferably, an anthracene derivative is a compound containing a phenylanthracene skeleton. Preferably, aromatic amine is 2, 3, or a compound contained four about a nitrogen atom replaced by aromatic series, and is a compound containing at least one alkenyl group still more preferably.

[0011]Preferably, a blue system dopant is at least one kind of compound chosen from styryl amine, an amine substitution styryl compound, or a fused aromatic ring content compound. Preferably, yellow - a red system dopant are compounds which carry out two or more owners of the fluoranthene skeleton. Preferably, yellow - a red system dopant are the compounds containing an electron releasing group and a fluoranthene skeleton. Preferably, yellow - fluorescence peak wavelength of a red system dopant are 540 nm - 700 nm. Preferably, thickness of a blue system luminous layer and yellow - a red system luminous layer is not less than 5 nm.

[0012]
[A mode of implementation of an invention] By this invention, the anode, a blue system luminous layer, yellow - a red system luminous layer, and the negative pole have laminated in this order, and a luminous layer comprises two-layer [of a blue system luminous layer and yellow - a red system luminous layer]. A blue system luminous layer is in the anode side, yellow - a red system luminous layer are in the negative pole side, and a host material of a blue system luminous layer, and yellow - a red system luminous layer is the same substance further. Other layers can be made to intervene between a blue system luminous layer, and yellow - a red system luminous layer. Other organic layers or inorganic layers can be made to intervene between the anode and a blue system luminous layer or between yellow - a red system luminous layer, and the negative pole. The intervening layer can convey an electron and an electron hole, and if transparent, it will not be restricted. As a desirable example, the oxidation In, oxidation Sn, oxidation Zn, sulfuration Zn, the sulfuration Cd, and the nitriding Ga are mentioned. As composition of a white system organic EL device of this invention, For example, anode / blue system luminous layer / yellow - red system luminous layer / negative pole anode / electron hole transporting bed / blue system luminous layer / yellow - red system luminous layer / negative pole anode / blue system luminous layer / yellow - red system luminous layer / electron transport layer / negative pole anode / electron hole transporting bed / blue system luminous layer / yellow - red system luminous layer / electron transport layer / negative pole anode / hole injection layer/. Although there are an electron hole transporting bed / blue system luminous layer / yellow - a red system luminous layer / electron transport layer / negative pole anode / hole injection layer / electron hole transporting bed / blue system luminous layer / yellow - a red system luminous layer / electron transport layer / electronic injection layer / negative pole, etc., It will not be limited especially if a blue system luminous layer has laminated from yellow - a red system luminous layer to the anode side.
[0013]Drawing 1 is a mimetic diagram of one embodiment of a white system organic EL device of this invention. The white system organic EL device 1 has the structure which laminated the anode 2, the hole injection layer (the first organic layer) 3, the electron hole transporting bed 4, the blue system luminous layer 5, yellow - the red system luminous layer 6, the electron transport layer (the second organic layer) 7, and the negative pole 8. As for this white system organic EL device 1, a luminous layer consists only of bilayer lamination of the blue system luminous layer 5, and yellow - the red system luminous layer 6.
[0014]In a white system organic EL device of this invention, since the anode side is a blue system luminous layer, a tendency for the luminescent color to incline toward red can be negated. Therefore, in order to obtain white, it is not necessary to press down yellow - red system luminescence, and it is not necessary to make thickness thin for yellow - a red system luminous layer compared with a blue system luminous layer, or to make dope concentration thin. As a result, since thickness of yellow - a red system luminous layer can be made thicker than before, there are few chromaticity variations. Since a host material of a blue system luminous layer, and yellow - a red system luminous layer is the same substance, it is hard to concentrate luminescence on an interface, and a blue light layer cannot receive influence by change of an interface easily. Since thickness of yellow - a red system luminous layer is large enough, it is hard to receive influence by change of an interface. Therefore, a white system organic EL device of this invention has few color changes, and it is at the bottom of hot environments, and continuation drive time, and especially, since it is hard to produce a color change, it can be used conveniently for information display equipment, mounted display equipment, a light, etc.

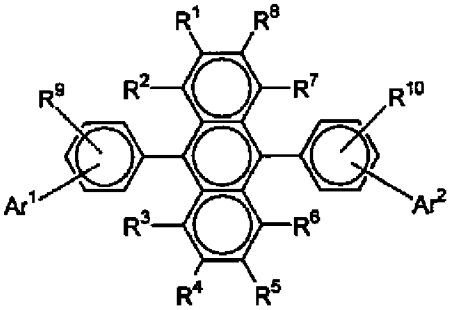
[0015]Hereafter, a blue system luminous layer and yellow - a red system luminous layer which are the characteristic portions of this invention are explained to a center. Therefore, since general composition can be taken, composition and a process of other organic layers, an inorganic compound layer, the anode, the negative pole, etc. are explained briefly.

[0016]1. A luminous layer (1) blue system luminous layer blue system luminous layer consists of a host material and a blue system dopant. As for a host material, it is preferred that they are a styryl derivative, an anthracene derivative, or aromatic amine. As for a styryl derivative, it is preferred that it is especially at least one kind chosen from a JISUCHIRIRU derivative, a tris CHIRIRU derivative, a tetra styryl derivative, and a styryl amine derivative. As for an anthracene derivative, it is preferred that it is especially a compound which has a phenylanthracene skeleton. As for aromatic amine, it is preferred that it is a compound which has 2-4 nitrogen atoms by which aromatic substitution was carried out, and especially its compound that has 2-4 nitrogen atoms by which aromatic substitution was carried out, and has at least one alkenyl group is preferred.

[0017]As the above-mentioned styryl derivative and an anthracene derivative, it is a following general formula, for example. [1]-A compound shown by [5] is a following general formula as the above-mentioned aromatic amine, for example. [6]-A compound shown by [7] is mentioned.

[0018]

[Formula 1]



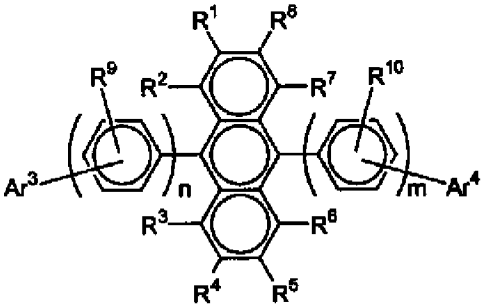
[1]

[0019][Independently R^1 - R^{10} among a formula, respectively A hydrogen atom, An alkyl group with 1-20 carbon atoms which are not replaced [a halogen atom, a cyano group, a nitro group, substitution, or], An aryloxy group with 6-30 carbon atoms which are not replaced [an alkoxy group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An arylthio group with 6-30 carbon atoms which are not replaced [an alkylthio group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], It is a heterocycle group with 5-30 carbon atoms which are not replaced [a condensed multi-ring group with 10-30 carbon atoms which are not replaced / an arylated alkyl group with 7-30 carbon atoms which are not replaced / substitution or /, a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or]. Independently, Ar^1 and Ar^2 are alkenyl groups which are not replaced [an aryl group with 6-30 carbon atoms which are not replaced / substitution or /, substitution, or], and, respectively as a substituent, An alkoxy group with 1-20 carbon atoms which are not replaced [an alkyl group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An alkylthio group with 1-20 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], An arylated alkyl group with 6-30 carbon atoms which are not replaced [an arylthio group with 6-30 carbon atoms which are not replaced / substitution or /, substitution

or], It is a heterocycle group with 5-30 carbon atoms which are not replaced [a condensed multi-ring group with 10-30 carbon atoms which are not replaced / a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or].]

[0020]

[Formula 2]

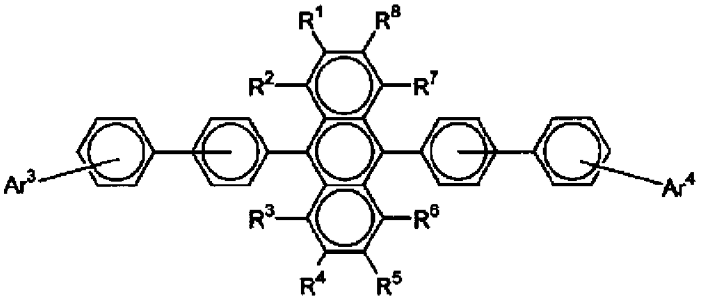


[2]

[0021][Independently R^1 - R^{10} among a formula, respectively A hydrogen atom, An alkyl group with 1-20 carbon atoms which are not replaced [a halogen atom, a cyano group, a nitro group, substitution, or], An aryloxy group with 6-30 carbon atoms which are not replaced [an alkoxy group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An arylthio group with 6-30 carbon atoms which are not replaced [an alkylthio group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], It is a heterocycle group with 5-30 carbon atoms which are not replaced [a condensed multi-ring group with 10-30 carbon atoms which are not replaced / an arylated alkyl group with 7-30 carbon atoms which are not replaced / substitution or /, a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or]. Independently, Ar^3 and Ar^4 are alkenyl groups which are not replaced [an aryl group with 6-30 carbon atoms which are not replaced / substitution or /, substitution, or], and, respectively as a substituent, An alkoxy group with 1-20 carbon atoms which are not replaced [an alkyl group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An alkylthio group with 1-20 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], An arylated alkyl group with 6-30 carbon atoms which are not replaced [an arylthio group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is an alkenyl group with 4-40 carbon atoms which are not replaced [a heterocycle group with 5-30 carbon atoms which are not replaced / a condensed multi-ring group with 10-30 carbon atoms which are not replaced / a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or /, substitution, or]. 1-3m of n are 1-3, and n+m>=2.]

[0022]

[Formula 3]

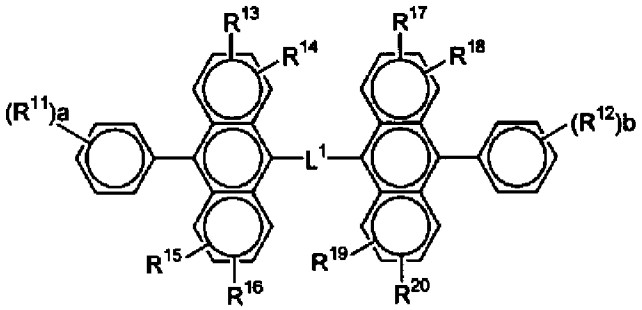


[3]

[0023][Independently R^1 - R^8 among a formula, respectively A hydrogen atom, An alkyl group with 1-20 carbon atoms which are not replaced [a halogen atom, a cyano group, a nitro group, substitution, or], An aryloxy group with 6-30 carbon atoms which are not replaced [an alkoxy group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An arylthio group with 6-30 carbon atoms which are not replaced [an alkylthio group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], It is a heterocycle group with 5-30 carbon atoms which are not replaced [a condensed multi-ring group with 10-30 carbon atoms which are not replaced / an arylated alkyl group with 7-30 carbon atoms which are not replaced / substitution or /, a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or]. Independently, Ar^3 and Ar^4 are alkenyl groups which are not replaced [an aryl group with 6-30 carbon atoms which are not replaced / substitution or /, substitution, or], and, respectively as a substituent, An alkoxy group with 1-20 carbon atoms which are not replaced [an alkyl group with 1-20 carbon atoms which are not replaced / substitution or /, substitution or], An alkylthio group with 1-20 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], An arylated alkyl group with 6-30 carbon atoms which are not replaced [an arylthio group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is an alkenyl group with 4-40 carbon atoms which are not replaced [a heterocycle group with 5-30 carbon atoms which are not replaced / a condensed multi-ring group with 10-30 carbon atoms which are not replaced / a monocycle group with 5-30 unreplaced carbon atoms, substitution, or /, substitution, or /, substitution, or].]

[0024]

[Formula 4]

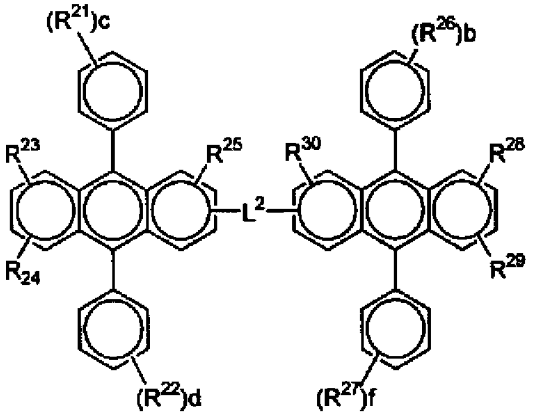


[4]

[0025][R^{11} - R^{20} among a formula, Independently, respectively A hydrogen atom, an alkenyl group, an alkyl group, a cycloalkyl group, An aryl group, an alkoxyl group, an aryloxy group, an alkylamino group, an arylamino group, or the heterocyclic group that may be replaced is shown, and a and b, The integer of 1-5 is shown, respectively, and when they are two or more, R^{11} or R^{12}. In each, it may be the same or may differ, and R^{11} or R^{12} may join together, may form the ring, and, R^{13}, R^{14} and R^{15}, R^{16} and R^{17}, R^{18} and R^{19}, and R^{20} may combine with it being, and may form the ring. L^1 shows a single bond or -O-, -S-, -N(R)- (R is an alkyl group or an aryl group which may be replaced), or an allylene group.]

[0026]

[Formula 5]

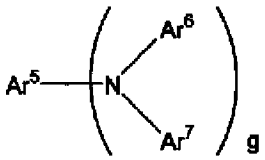


[5]

[0027][R^{21} - R^{30} among a formula, Independently, respectively A hydrogen atom, an alkenyl group, an alkyl group, a cycloalkyl group, An aryl group, an alkoxyl group, an aryloxy group, an alkylamino group, an arylamino group, or two or more cyclic group that may be replaced is shown, and c, d, e, and f, The integer of 1-5 is shown, respectively, and when they are two or more, R^{21}, R^{22}, R^{26}, or R^{27}. In each, it may be the same, or may differ and R^{21}.R^{22}, R^{26}, or R^{27} may join together, the ring may be formed, and R^{23}, R^{24} and R^{28}, and R^{29} may combine with it being, and may form the ring. L^2 shows a single bond or -O-, -S-, -N(R)- (R is an alkyl group or an aryl group which may be replaced), or an allylene group.]

[0028]

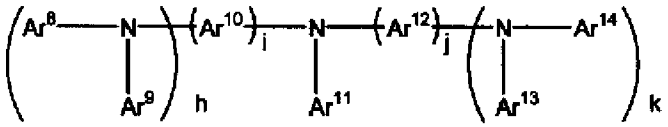
[Formula 6]



[6]

[0029][Among a formula, Ar^5, Ar^6, and Ar^7 show independently the aromatic group of the monovalence which is not replaced [substitution with 6-40 carbon atoms, or], respectively, at least one in them may contain the styryl group, and g shows the integer of 1-4.]

[Formula 7]



[7]

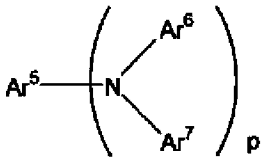
[0030][Ar^8, Ar^9, Ar^{11}, Ar^{13}, and Ar^{14} among a formula, The aromatic group of the monovalence which is not replaced [substitution with 6-40 carbon atoms or] is shown independently, respectively, and Ar^{10} and Ar^{12}, The aromatic group of the bivalence which is not replaced [substitution with 6-40 carbon atoms or] is shown independently, respectively, at least one of Ar^8 - the Ar^{14} may contain the styryl group or the Styr Wren group, and the integer of 0-2, and i and j of h and k are the integers of 0-3, respectively.]

[0031]As for a blue system dopant, it is preferred that it is at least one kind chosen from styryl amine, an amine substitution styryl compound, and a fused aromatic ring content compound. Then, a blue system dopant comprises several different compounds, and its potato is good. As the above-mentioned styryl amine and an amine substitution styryl compound, it is a following general formula, for example. [8]-A compound

shown by [9] is a following general formula as the above-mentioned fused aromatic ring content compound, for example. A compound shown by [10] is mentioned.

[0032]

[Formula 8]

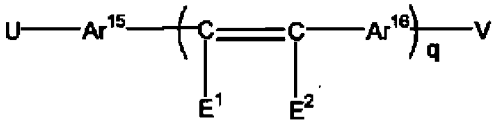


[8]

[0033][Ar^5, Ar^6, and Ar^7 show independently the aromatic group which is not replaced [substitution with 6-40 carbon atoms, or] among a formula, respectively, and, as for p, at least one in them shows the integer of 1-3 including a styryl group.]

[0034]

[Formula 9]

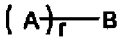


[9]

[0035][Among a formula, independently, the allylene group, E^1, and E^2 with 6-30 carbon atoms show an aryl group or an alkyl group, a hydrogen atom, or a cyano group with 6-30 carbon atoms independently, respectively, and, as for Ar^{15} and Ar^{16}, q shows the integer of 1-3, respectively. U and/or V are the substituents containing an amino group, and are preferred in this amino group being an arylamino group.]

[0036]

[Formula 10]



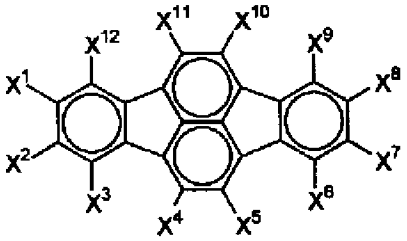
[10]

[0037][A among a formula An alkyl group or an alkoxy group with 1-16 carbon atoms, The arylamino group which is not replaced [substitution with the alkylamino group which is not replaced / substitution with the aryl group which is not replaced / substitution with 6-30 carbon atoms or / and 6-30 carbon atoms or / or 6-30 carbon atoms or] and B show a fused aromatic ring group with 10-40 carbon atoms, and r shows the integer of 1-4.]

[0038](2) Yellow - red system luminous layer yellow - a red system luminous layer consist of a host material, and yellow - a red system dopant. A host material uses the same thing as a host material used by a blue system luminous layer. When different host materials are used, since a color change becomes large, it is not desirable. A fluorescent compound which has at least one fluoranthene skeleton or a perylene skeleton can be used for yellow - a red system dopant, for example, they are a following general formula. [11]-A compound shown by [27] is mentioned.

[0039]

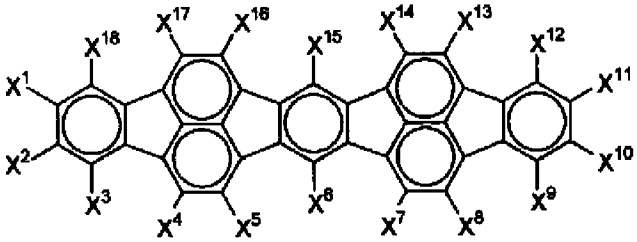
[Formula 11]



[11]

[0040]

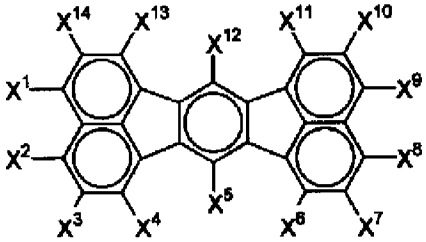
[Formula 12]



[12]

[0041]

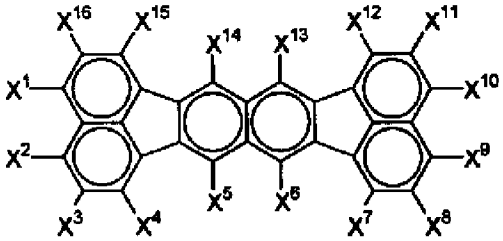
[Formula 13]



[13]

[0042]

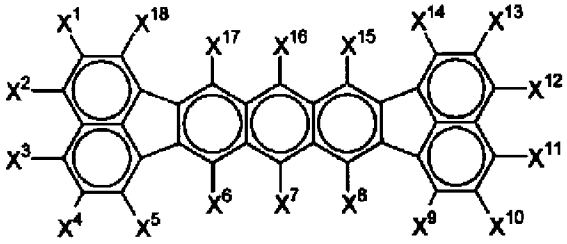
[Formula 14]



[14]

[0043]

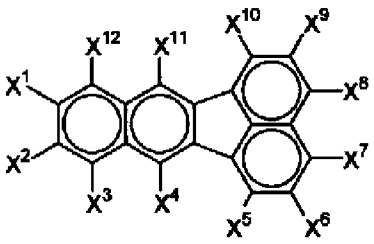
[Formula 15]



[15]

[0044]

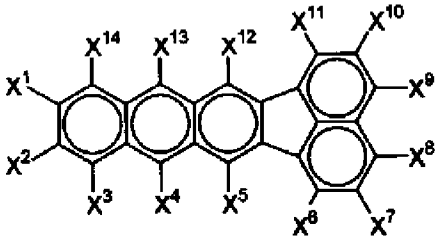
[Formula 16]



[16]

[0045]

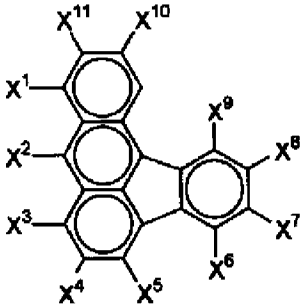
[Formula 17]



[17]

[0046]

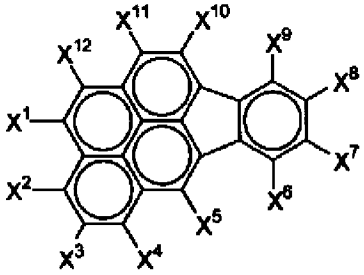
[Formula 18]



[18]

[0047]

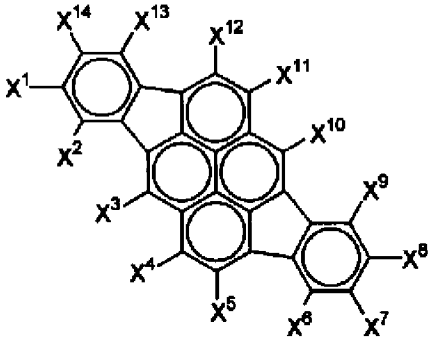
[Formula 19]



[19]

[0048]

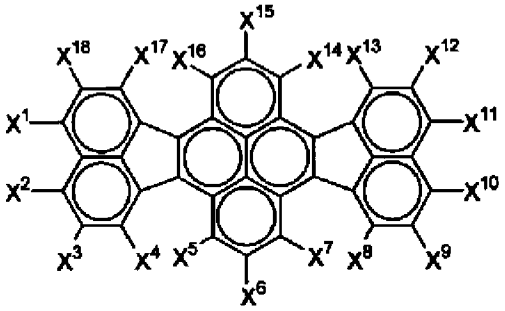
[Formula 20]



[20]

[0049]

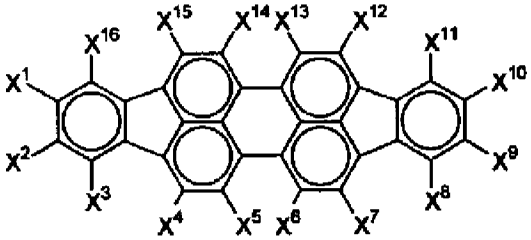
[Formula 21]



[21]

[0050]

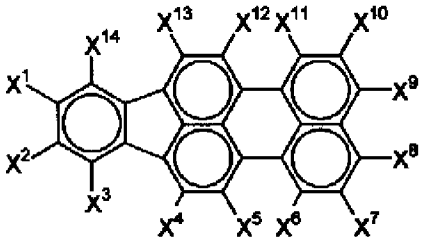
[Formula 22]



[22]

[0051]

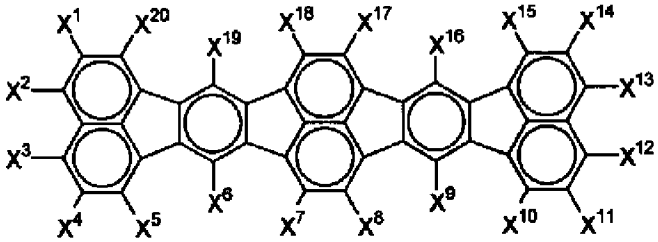
[Formula 23]



[23]

[0052]

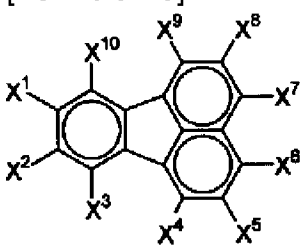
[Formula 24]



[24]

[0053]

[Formula 25]

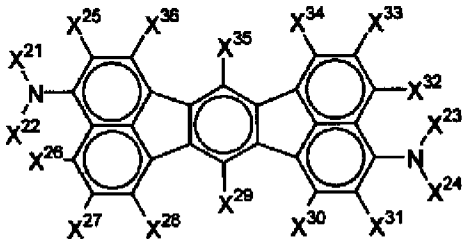


[25]

[0054][General formula [11]-[25]Independently X^1 - X^{20} among a formula, respectively A hydrogen atom, An alkyl group with a straight chain, branching, or 1-20 annular carbon atoms, a straight chain, An aryl group with 6-30 carbon atoms which are not replaced [an alkoxy group with branching or 1-20 annular carbon atoms, substitution or], An arylamino group with 6-30 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is an alkenyl group with an aryl alkylamino group with 7-30 carbon atoms which are not replaced [an alkylamino group with 1-30 carbon atoms which are not replaced / substitution or /, substitution, or], substitution, or 8-30 unreplaced carbon atoms, An adjoining substituent and X^1 - X^{20} may form cyclic structure unitedly. A substituent may be the same when the adjoining substituent is an aryl group.]General formula[11]-[25]When the compound of a formula contains an amino group or an alkenyl group, it is preferred.

[0055]

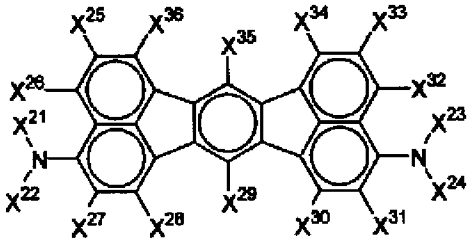
[Formula 26]



[26]

[0056]

[Formula 27]



[27]

[0057][General formula [26]-[27]Independently X^{21} - X^{24} among a formula, respectively An alkyl group with 1-20 carbon atoms, It is an aryl group with 6-30 carbon atoms which are not replaced [substitution or], and X^{21}, X^{22} and/or X^{23}, and X^{24} may be combined via carbon-carbon bonding or -O-, and -S-. X^{25} - X^{36} A hydrogen atom, a straight chain, branching, or an alkyl group with 1-20 annular carbon atoms, An aryl group with 6-30 carbon atoms which are not replaced [an alkoxy group with a straight chain, branching, or 1-20 annular carbon atoms, substitution, or], An arylamino group with 6-30 carbon atoms which are not replaced [an aryloxy group with 6-30 carbon atoms which are not replaced / substitution or /, substitution or], It is an alkenyl group with an aryl alkylamino group with 7-30 carbon atoms which are not replaced [an alkylamino group with 1-30 carbon atoms which are not replaced / substitution or /, substitution, or], substitution, or 8-30 unreplaced carbon atoms, An adjoining substituent and X^{25} - X^{36} may form cyclic structure unitedly. It is desirable when at least one of substituent X^{25} in each formula - the X^{36} contains amine or an alkenyl group.]

[0058]As for a fluorescent compound which has a fluoranthene skeleton, in order efficient and to acquire a

long life, it is preferred to contain an electron releasing group, and a desirable electron releasing group is an arylamino group which is not replaced [substitution or]. As for a fluorescent compound which has a fluoranthene skeleton, five or more are preferred in the number of condensed rings, and six especially or more are preferred. This is because a fluorescent compound shows fluorescence peak wavelength of 540-700 nm, luminescence from a fluorescent compound laps with a blue system luminescent material and it assumes white. When the above-mentioned fluorescent compound carries out two or more owners of the fluoranthene skeleton, since the luminescent color serves as a red spectrum region from yellow, it is preferred. Especially a desirable fluorescent compound has an electron releasing group, a fluoranthene skeleton, or a perylene skeleton, and shows fluorescence peak wavelength of 540-700 nm.

[0059]5-30 nm of thickness [7-30 nm of] of a blue system luminous layer is 10-30 nm preferably. In less than 5 nm, when there is a possibility that luminous layer formation may become difficult and adjustment of a chromaticity may become difficult and it exceeds 30 nm, there is a possibility that driver voltage may go up. 10-50 nm of thickness [20-50 nm of] of yellow - a red system luminous layer is 30-50 nm preferably. In less than 10 nm, when there is a possibility that luminous efficiency may fall and it exceeds 50 nm, there is a possibility that driver voltage may go up.

[0060]2. Organic layer (1) which is others Between the first organic layer anode and a blue system luminous layer, a hole injection layer, an electron hole transporting bed, or an organic semiconductor layer can be provided as the first organic layer. It is a layer which helps a hole injection to a luminous layer and is conveyed to a luminous region, a hole injection layer or an electron hole transporting bed has large hole mobility, and its ionization energy is usually as small as 5.5 eV or less. A hole injection layer provides easing a sudden change of energy level etc. in order to adjust energy level. Material which conveys an electron hole to a luminous layer with lower field intensity as such a hole injection layer or an electron hole transporting bed is preferred, That whose mobility of an electron hole is $10^{-6}cm^2/V$ and a second at least, for example at the time of an applied electric field of 10^4 - 10^6V/cm is still more preferred. As a material which forms a hole injection layer or an electron hole transporting bed, If it has the aforementioned desirable character, there will be no restriction in particular, and arbitrary things can be conventionally chosen and used out of what is commonly used as a charge transporting material of an electron hole in photoconductive material, and a publicly known thing currently used for a hole injection layer of an organic EL device.

[0061]As a formation material of such a hole injection layer or an electron hole transporting bed, Specifically, for example A triazole derivative (references, such as a U.S. Pat. No. 3,112,197 item specification), An oxadiazole derivative (references, such as a U.S. Pat. No. 3,189,447 item specification), an imidazole derivative (references, such as JP,37-16096,B) and a poly aryl alkane derivative (a U.S. Pat. No. 3,615,402 item specification.) A 3,820,989 specification, a 3,542,544 specification, JP,45-555,B, a 51-10983 gazette, JP,51-93224,A, A 55-17105 gazette, a 56-4148 gazette, a 55-108667 gazette, References, such as a 55-156953 gazette and a 56-36656 gazette, a pyrazoline derivative and a pyrazolone derivative (a U.S. Pat. No. 3,180,729 specification.) A 4,278,746 specification, JP,55-88064,A, References, such as a 55-88065 gazette, a 49-105537 gazette, a 55-51086 gazette, a 56-80051 gazette, a 56-88141 gazette, a 57-45545 gazette, a 54-112637 gazette, and a 55-74546 gazette, a phenylenediamine derivative (a U.S. Pat. No. 3,615,404 specification.) JP,51-10105,B, a 46-3712 gazette, a 47-25336 gazette, References, such as JP,54-53435,A, a 54-110536 gazette, and a 54-119925 gazette, an arylamine derivative (a U.S. Pat. No.

3,567,450 specification and a 3,180,703 specification.) A 3,240,597 specification, a 3,658,520 specification, A 4,232,103 specification, a 4,175,961 specification, A 4,012,376 specification, JP,49-35702,B, A 39-27577 gazette, JP,55-144250,A, a 56-119132 gazette, References, such as a 56-22437 gazette and the West German patent No. 1,110,518 specification, An amino substitution chalcone derivative (references, such as a U.S. Pat. No. 3,526,501 specification), An oxazole derivative (thing of an indication on U.S. Pat. No. 3,257,203 specifications etc.), a styryl anthracene derivative (references, such as JP,56-46234,A), a fluorenone derivative (references, such as JP,54-110837,A), a hydrazone derivative (a U.S. Pat. No. 3,717,462 specification and JP,54-59143,A.) A 55-52063 gazette, a 55-52064 gazette, a 55-46760 gazette, A 55-85495 gazette, a 57-11350 gazette, a 57-148749 gazette, references, such as JP,2-311591,A, and a stilbene derivative (JP,61-210363,A.) The No. 228451 [61 to] gazette, a 61-14642 gazette, a 61-72255 gazette, A 62-47646 gazette, a 62-36674 gazette, a 62-10652 gazette, A 62-30255 gazette, a 60-93455 gazette, a 60-94462 gazette, References, such as a 60-174749 gazette and a 60-175052 gazette, A silazane derivative (U.S. Pat. No. 4,950,950 specification), a polysilane system (JP,2-204996,A), Conductive polymer oligomer (especially thiophene oligomer) etc. which are indicated by an aniline system copolymer (JP,2-282263,A) and JP,1-211399,A can be mentioned.

[0062]As a material of a hole injection layer or an electron hole transporting bed, although the above-mentioned thing can be used, A porphyrin compound (thing of an indication to JP,63-2956965,A etc.), an aromatic tertiary-amine compound and a styryl amine compound (a U.S. Pat. No. 4,127,412 specification.) JP,53-27033,A, a 54-58445 gazette, a 54-149634 gazette, Reference and aromatic tertiary-amine compounds, such as a 54-64299 gazette, a 55-79450 gazette, a 55-144250 gazette, a 56-119132 gazette, a 61-295558 gazette, a 61-98353 gazette, and a 63-295695 gazette, can also be used. . Have in intramolecular two fused aromatic rings indicated to U.S. Pat. No. 5,061,569. For example, 4,4'-bis(N-(1-naphthyl)-N-phenylamino)biphenyl, A triphenylamine unit indicated to JP,4-308688,A can mention a 4,4',4"-tris(N-(3-methylphenyl)-N-phenylamino) triphenylamine etc. which were connected with 3 starburst type. Inorganic compounds, such as p type Si, p type SiC, etc. besides the above-mentioned aromatic JIMECHIRI DIN system compound shown as a material of a luminous layer, can also be used as a material of a hole injection layer or an electron hole transporting bed.

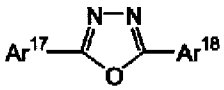
[0063]This hole injection layer or an electron hole transporting bed may laminate a hole injection layer or an electron hole transporting bed which may comprise one layer which consists of one sort of material mentioned above, or two sorts or more, and turns into a hole injection layer or an electron hole transporting bed from a compound of another kind. Although thickness in particular of a hole injection layer or an electron hole transporting bed is not limited, it is 20-200 nm preferably.

[0064]An organic semiconductor layer is a layer which helps a hole injection or electron injection to a luminous layer, and what has the conductivity more than 10^{-10}S/cm is preferred for it. As a material of such an organic semiconductor layer, conductive dendrimers, such as conductive oligomer, such as ** thiophene oligomer and ** arylamine oligomer given in JP,8-193191,A, and a ** arylamine dendrimer, etc. can be used. Although thickness in particular of an organic semiconductor layer is not limited, it is 10-1,000 nm preferably.

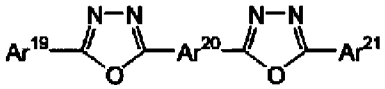
[0065](2) Between the second organic layer negative pole, and yellow - a red system luminous layer, an electronic injection layer or an electron transport layer can be provided as the second organic layer. An electronic injection layer or an electron transport layer is a layer which helps pouring of an electron to a

luminous layer, and its electron mobility is large.An electronic injection layer provides easing a sudden change of energy level etc. in order to adjust energy level. As a material used for an electronic injection layer or an electron transport layer, a metal complex of 8-hydroxyquinoline or its derivative is preferred.As an example of a metal complex of the above-mentioned 8-hydroxyquinoline or its derivative, a metal chelate oxy NOIDO compound, for example, tris(eight quinolinol) aluminum, containing chelate of oxine (generally an eight quinolinol or 8-hydroxyquinoline) can be used. And as an oxadiazole derivative, it is following general formula [28] - [30]. [0066]

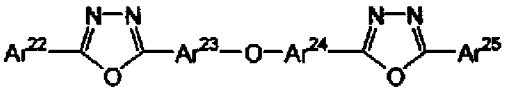
[Formula 28]



[28]



[29]

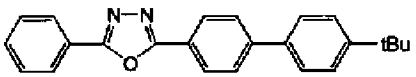


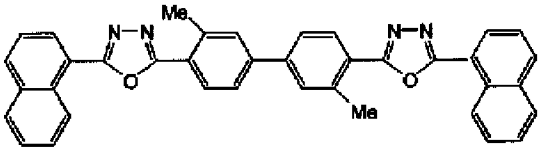
[30]

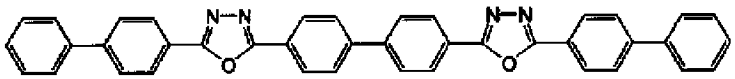
[0067](Ar^{17}, Ar^{18}, Ar^{19}, Ar^{21}, Ar^{22}, and Ar^{25} among a formula) The aryl group which it does not have or it has a substituent, respectively is shown, and Ar^{17}, Ar^{18} and Ar^{19}, Ar^{21} and Ar^{22}, and Ar^{25} may be mutually the same, or may differ from each other. Ar^{20}, Ar^{23}, and Ar^{24} show the allylene group which it does not have or it has a substituent, respectively, may be mutually the same, or may differ. The electron transport compound expressed is mentioned. [of Ar^{23} and Ar^{24}] These general formulas [28] As an aryl group in - [30], a phenyl group, a biphenyl group, an anthranil, a peri RENIRU group, a pyrenyl group, etc. are mentioned. As an allylene group, a phenylene group, a naphthylene group, a biphenylene group, the Ain Trani Wren group, the Pelli Reni Wren group, a pyrenylene group, etc. are mentioned. And as a substituent to these, the alkyl group of the carbon numbers 1-10, the alkoxy group of the carbon numbers 1-10, or a cyano group is mentioned. What has thin-film-forming nature good [this electron transport compound] is used preferably. And the following can be mentioned as an example of these electron transport nature compound.

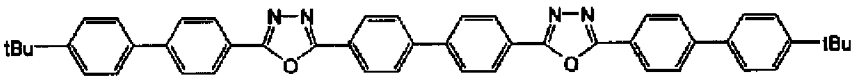
[0068]

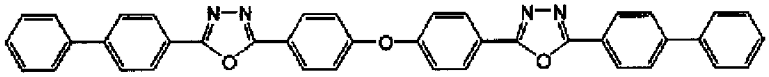
[Formula 29]











Although the thickness in particular of an electronic injection layer or an electron transport layer is not limited, it is 1-100 nm preferably.

[0069]It is preferred that the blue system luminous layer or the first organic layer nearest to the anode which is an organic layer contains the oxidizer. The desirable oxidizer contained in a luminous layer or the first organic layer is electronic suction nature or an electronic acceptor. They are the salts preferably formed with a Lewis acid, various quinone derivative, and dicyanoquinodimethane derivative, and aromatic amine and Lewis acid. Especially desirable Lewis acid is ferric chloride, an antimony chloride, an aluminium chloride, etc.

[0070]It is preferred that the yellow - the red system luminous layer, or the second organic layer which is an organic layer nearest to the negative pole contains the reducing agent. A desirable reducing agent is a complex formed with an alkaline metal, alkaline-earth metals, an alkali metal oxide, an alkaline earth oxide, a rare earth oxide, alkali metal halides, an alkaline earth halogenide, a rare earth halogenide, and an alkaline metal and aromatic compounds. Especially desirable alkaline metals are Cs, Li, Na, and K.

[0071]3. In contact with the inorganic compound layer anode and/or the negative pole, it may have an inorganic compound layer. An inorganic compound layer functions as an adhesion improvement layer. As a desirable inorganic compound used for an inorganic compound layer, An alkali metal oxide, an alkaline earth oxide, a rare earth oxide, alkali metal halides, An alkaline earth halogenide, a rare earth halogenide, SiO_X, They are various oxides, such as AlO_X, SiN_X, SiON, AlON, GeO_X, LiO_X, LiON, TiO_X, TiON, TaO_X, TaON, TaN_X, and C, a nitride, and an oxidation nitride. As an ingredient of a layer which touches especially the anode, SiO_X, AlO_X, SiN_X, SiON, AlON, GeO_X, and C form a stable pouring volume phase, and are preferred. As an ingredient of a layer which touches especially the negative pole, LiF, MgF_2, CaF_2, MgF_2, and NaF are preferred. Although thickness in particular of an inorganic compound layer is not limited, it is 0.1 nm - 100 nm preferably.

[0072]Although a method in particular of forming each organic layer and an inorganic compound layer containing a luminous layer is not limited, it can apply publicly known methods, such as vacuum deposition, a spin coat method, the cast method, and the LB method, for example. Since the characteristic of an organic

EL device obtained becomes uniform and production time can be shortened, forming by same method is preferred, for example, when producing an electronic injection layer with vacuum deposition, it is preferred [an electronic injection layer and a luminous layer] that a luminous layer also produces a film with vacuum deposition.

[0073]4. It is preferred to use large (for example, not less than 4.0 eV) metal, an alloy, electrical conductivity compounds, or these mixtures of a work function as the electrode anode. It is independent or, specifically, one sort, such as indium tin oxide (ITO), indium zinc oxide, tin, a zinc oxide, gold, platinum, and palladium, can be used combining two or more sorts.

[0074]Although thickness in particular of the anode is not restricted, either, it is preferred to consider it as a value within the limits of 10-1,000 nm, and it is more preferred to consider it as a value within limits which are 10-200 nm.

[0075]It is preferred to use small (for example, less than 4.0 eV) metal, an alloy, electric conductivity compounds, or these mixtures of a work function for the negative pole. It is independent or, specifically, one sort, such as magnesium, aluminum, indium, lithium, sodium, and silver, can be used combining two or more sorts. Although thickness in particular of the negative pole is not restricted, either, it is preferred to consider it as a value within the limits of 10-1000 nm, and it is more preferred to consider it as a value within limits which are 10-200 nm. As for either [at least] the anode or the negative pole it is substantially preferred transparence and that light transmittance is more specifically not less than 10% of value so that light emitted from a luminous layer can be taken out effective in the exterior. An electrode can be manufactured with a vacuum deposition method, sputtering process, the ion plating method, electron beam evaporation method, a CVD method, the MOCVD method, plasma CVD method, etc. [0076]Hereafter, this invention is not limited by these examples although an example of this invention is described. The evaluation of an organic EL device obtained in each example is as follows.

(1) Initial performance : CIE1931 chromaticity coordinate measured and estimated a chromaticity.

(2) Life : the constant current drive was carried out by initial luminance 1000 cd/m^2, and half-life of luminosity and change of a chromaticity estimated.

(3) Heat resistance : a retention test was carried out at 105 ** and a chromaticity variation 500 hours after estimated. L/J change is change when early L/J expressed with a ratio of the luminosity L to the current density J is set to one.

[Translation done.]

* NOTICES *

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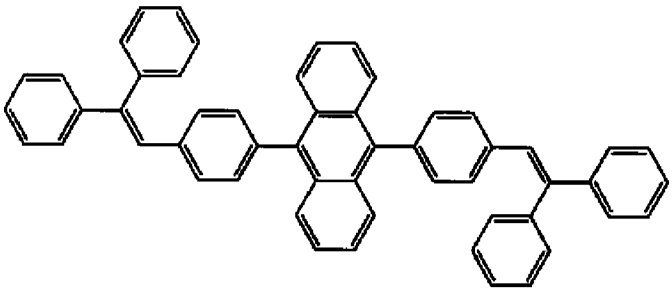
EXAMPLE

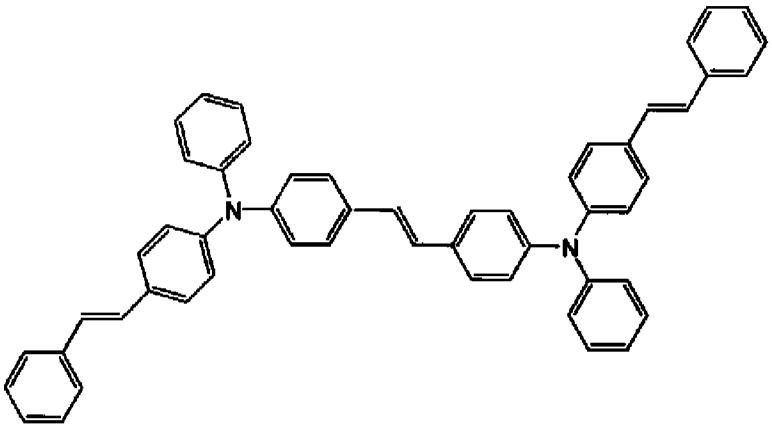
[Example]After cleaning ultrasonically the glass substrate with an ITO transparent electrode (anode) (made by a JIOMA tick company) of 75 mm x example 1(formation of organic EL device)25-mmx1.1-mm thickness for 5 minutes in isopropyl alcohol, UV ozone wash was performed for 30 minutes. The substrate holder of a vacuum evaporator is equipped with the glass substrate with a transparent electrode line after washing, So that said transparent electrode may be covered on the field of the side in which the transparent electrode line is formed first. It carried out and the N,N'-bis(N,N'-diphenyl-4-aminophenyl)-N,N-diphenyl-4,4'-diamino-1,1'-biphenyl film (it outlines the following "TPD232 film") of 60 nm of thickness was formed. This TPD232 film functions as a hole injection layer. The 4,4'-screw [N-(1-naphthyl)-N-phenylamino] biphenyl film (it outlines the following "NPD film") of 20 nm of thickness was formed on this TPD232 film after membrane formation of TPD232 film. This NPD film functions as an electron hole transporting bed.
[0078]It continues to membrane formation of a NPD film, and is a formula at 10 nm of thickness. The styryl derivative DPVPDAN and formula which are shown by [31] B1 shown by [32] was vapor-deposited by the weight ratio of 40:1, membranes were formed, and it was considered as the blue system luminous layer. Subsequently, they are the styryl derivative DPVPDAN and a formula at 30 nm. R1 (fluorescence peak wavelength of 545 nm) shown by [33] was vapor-deposited by the weight ratio of 40:1, membranes were formed, and it was considered as yellow - a red system luminous layer. On this film, the tris (eight quinolinol) aluminum film (it outlines the following "Alq film".) of 10 nm of thickness was formed as an electron transport layer. then, Li (the source of Li: made by a SAESU getter company) and Alq -- duality -- it was made to vapor-deposit and 10 nm of Alq:Li films were formed as an electronic injection layer. On this Alq:Li film, 150 nm of metal aluminum was made to vapor-deposit, metal cathode was formed, and the organic electroluminescence light emitting device was formed.
[0079]
[Formula 30]



[31]

[0080]

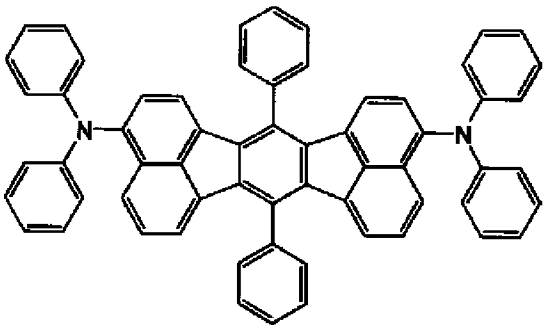
[Formula 31]



[32]

[0081]

[Formula 32]



[33]

[0082](Quality assessment of an organic EL device) As for this element, the white light of light-emitting-luminance 100 cd/m^2 and efficiency 7 cd/A maximum light-emitting-luminance 110,000 cd/m^2 was obtained with the direct current voltage 5V. In CIE1931 chromaticity coordinate, the element produced with this material is = (x, y) (0.282-0.281), and was checked as it is white. When the constant current drive of this element was carried out by initial luminance 1000 cd/m^2, a life is 10,000 hours and was excellent. When the retention test was carried out at 105 **, the chromaticity after 500 hours is (0.278-0.271), and it has checked that the color differences in examination order were (-0.004, -0.010), and were excellent. The initial performance, the life, and the heat-resistant measurement result of the organic EL device obtained by Example 1 and the following comparative examples 1-3 are shown in Table 1. It is long-life, the organic EL device of this example had high heat resistance, and there were few color changes so that clearly from this table.

[0083]The element was produced like comparative example 1 Example 1. However, on a NPD film, vapor-deposit the styryl derivative DPVDPAN and a compound (R1) by the weight ratio of 100:1 at 10 nm, and it is considered as yellow - a red system luminous layer, Furthermore, the styryl derivative DPVDPAN and the compound (B1) were vapor-deposited by the weight ratio of 40:1, membranes were formed by 10 nm of thickness, and it was considered as the blue system luminous layer. However, it was set to (0.417-0.436), and a chromaticity became yellow light rather than was white. Although a 105 ** retention test was carried out, compared with Example 1, the chromaticity variation was very large.

[0084]The element was produced like comparative example 2 Example 1. However, on a NPD film, vapor-

deposit the styryl derivative DPVDPAN and a compound (R1) by the weight ratio of 300:1 at 5 nm, and it is considered as yellow - a red system luminous layer, Furthermore, the styryl derivative DPVDPAN and the compound (B1) were vapor-deposited by the weight ratio of 40:1, membranes were formed by 38 nm of thickness, and it was considered as the blue system luminous layer. The chromaticity was set to (0.321-0.341) and good white was obtained. However, in a 105 ** retention test, the chromaticity variation became large compared with Example 1.

[0085]Element production was carried out like comparative example 3 Example 1. however, NPD, simultaneously (R1) were doped at a rate of 40:1 as an electron hole transporting bed. The luminous layer was made only into the blue system luminous layer, and the thickness of the blue system luminous layer was 40 nm.

[0086]

[Table 1]

	初期性能	室温連続駆動		耐熱性	
	色度	半減寿命 (h)	色度変化	L/J 変化	色度変化
実施例 1	(0.282, 0.281)	10000	(0.015, 0.015)	1.17	(-0.004, -0.010)
比較例 1	(0.417, 0.436)	7000	(0.015, 0.020)	1.44	(0.024, 0.034)
比較例 2	(0.321, 0.341)	10000	(0.015, 0.015)	1.20	(0.012, 0.019)
比較例 3	(0.330, 0.345)	8000	(0.018, 0.024)	1.20	(0.025, 0.036)

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a mimetic diagram of the white system organic EL device concerning one embodiment of this invention.
[Description of Notations]
1 White system organic EL device
2 Anode
3 Hole injection layer (the 1st organic layer)
4 Electron hole transporting bed
5 Blue system luminous layer
6 Yellow - a red system luminous layer
7 Electron transport layer (the 2nd organic layer)
8 Negative pole

[Translation done.]

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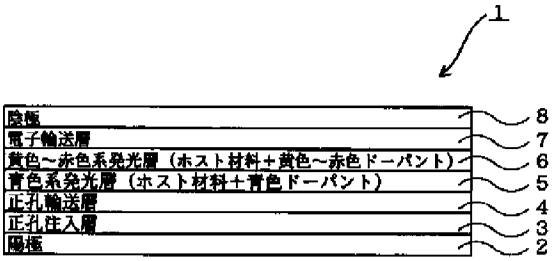
DRAWINGS

[Drawing 1]



[Translation done.]